SCIENTIFIC AMERICAN

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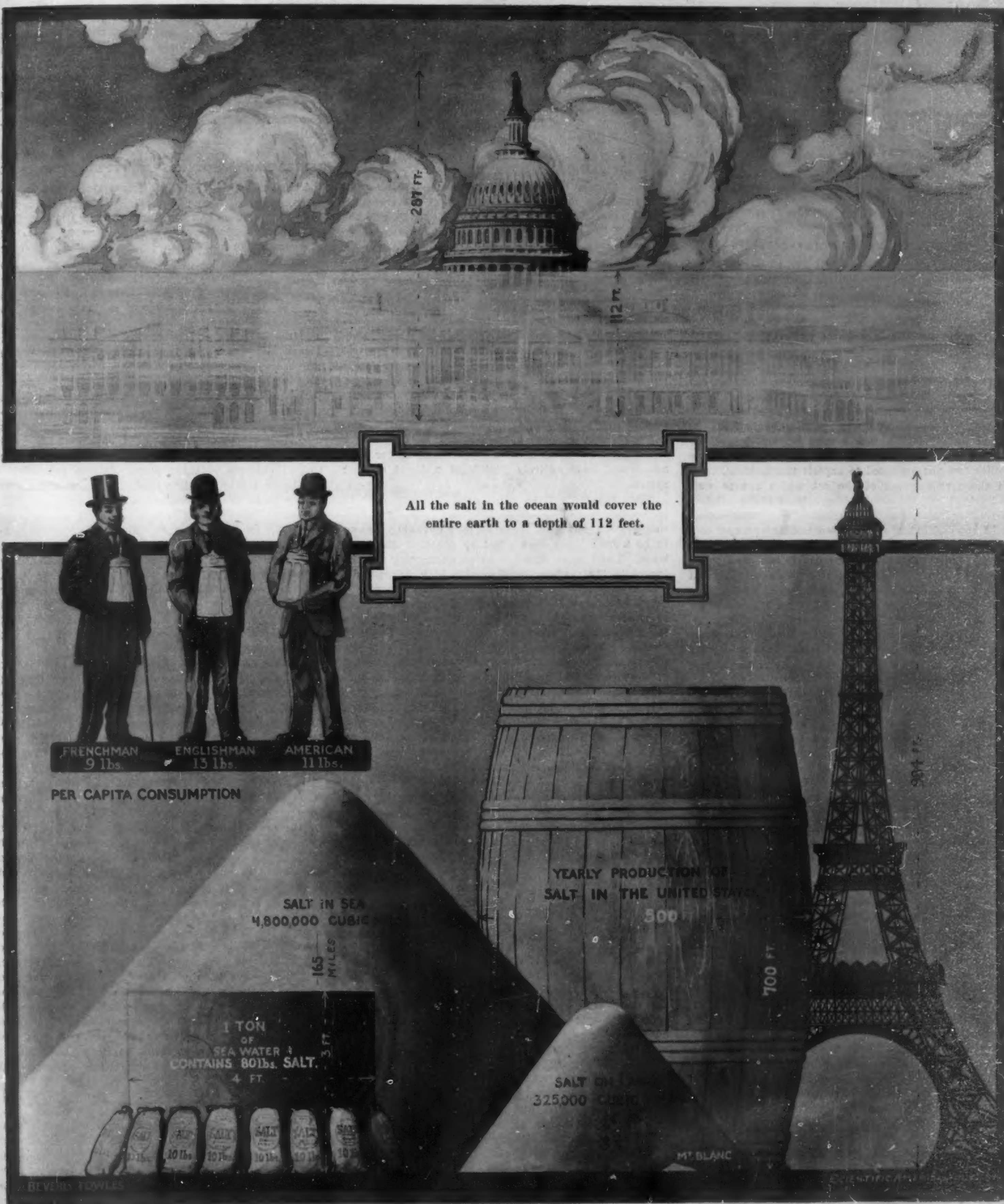

Salt in sea and on land.—Yearly production in the United States. 157,267,544 tons of sodium are annually poured into the sea. Of this amount, 77¾ per cent is common salt.

MAGNITUDE OF THE SALT INDUSTRY.—[See page 470.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, DECEMBER 26, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

GATUN DAM FACTS PERVERTED.

It seems to be the fate of every great national enterprise undertaken by the United States to be assailed by a more or less numerous, and always vociferous, crowd of detractors and prophets of disaster. Such has been, and evidently will continue to be, the fate of the Panama Canal. The latest evidence of this was the altogether misleading statement that the settlement of a small section of the Gatun dam proved that the site for the dam was unstable, and that the structure, when completed, must inevitably cave in and let loose the waters of the great Gatun Lake.

From the newspaper point of view, this item, as cabled from Panama, was a most attractive piece of sensationalism; and one of the leading New York dailies has not hesitated to exploit the incident, with all those refinements of the art which are so well understood and remorselessly practised to-day. Interviews were sought with engineers who were known to be opposed to the present lock-and-lake plan of construction as adopted by the government, and their lurid predictions of what would happen, if the canal were completed along the present lines, were spread upon many a page of the journal in question.

Now, the SCIENTIFIC AMERICAN is in a position to assure its readers that this subsidence of a small portion of the dam is a matter of no significance whatever, and gives not the slightest reason to suppose that the dam when raised to its full height will not be perfectly stable.

The Gatun dam, as completed, will consist of an artificial mound of sand and clay, 135 feet in height, about 1,800 feet in width, and extending for 8,000 or 9,000 feet across the valley of the Chagres River from hillside to hillside. This huge mound is to be formed by means of suction dredges, which will pump sand and clay, mixed with water, from the bed of the Chagres River below the dam, on to the site of the dam. Here, as the water drains away, the sand and clay will settle into a mass of very close consistency, so close as to be impervious to seepage. In order to confine the deposited material within the proper width of 1,800 feet, and prevent it from flowing away with the water, two walls of loose rock are being built entirely across the valley, one at the foot of the slope on the upstream side or lake side of the dam, and the other on the downstream side. The wall along the upstream toe, as completed, will be 30 feet broad at the top and 60 feet high. As the rock fill was being built out across the valley it crossed the old French canal channel, which runs through the site of the dam. During the past twenty years this channel had become filled with silt and soft mud; and the engineers decided that, instead of excavating this material until firm bottom was reached, it would be more economical to dump the rock directly upon the mud, and allow the fill as thus formed to settle through the mud until it reached firm ground. As the fill was raised in height, its weight at length became such that the expected displacement occurred, the rock settling down and forcing the mud up into mounds on either side of the fill. So far from the settling causing any concern to the engineers, it is exactly what they expected to take place; and the greater the settlement, the more they will be pleased. There is nothing new in this, and certainly nothing to warrant the attempt to stir up public apprehension, to say nothing of Congressional anxiety, regarding the stability of the dam. Railroad embankments are being made every day by this very method of displacement; and when the rock fill at the toe of the Gatun dam has finally reached the underlying solid material, which it will do long before the dam is completed, the public need have no anxiety as to further settlement.

FASHIONS IN ELECTRIC SYSTEMS.

The views presented by an entirely disinterested and impartial critic, Mr. M. E. Uytborck of the Belgian State Railways, in the Bulletin of the International Railway Congress, describing his "Journey of Inquiry" in the United States, form a topic not a little suggestive in the light of other recent publications on the subject of electrical equipment.

Mr. Renshaw, in the December Electrical Journal, points out with admirable clearness and in a manner interesting to others besides the technically trained electrical engineer, the advantages of the monophase alternating current system. The paper of Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad, presented before the American Institute of Electrical Engineers, however much it is to be commended for its frank discussion in the interests of science of the difficulties encountered in the electrification of that railroad, is quite as much a record of failure of the monophase system in its usual application as of the successful overcoming of unexpected difficulties.

The principal advantage of the monophase alternating system is briefly that it permits of the transmission by *two* conductors only—the trolley wire and the track—of those high voltages by which alone considerable economy in the first cost of conductors may be effected, and which are at the same time readily reduced to a safe working tension with almost no loss by means of entirely automatic and comparatively inexpensive static transformers. The design of a method of trolley line construction by means of which the high-voltage wires can be safely secured, of transformers portable on each car and of motors and control apparatus comparable in simplicity to those for direct current, has permitted the introduction of rural and interurban lines using this system, where the agricultural produce and similar freight traffic had to be created and the minimum expense was essential, and where the first cost of conductors, or rotary converter substations and feeders for an equivalent motor voltage, would have entirely prohibited a direct current system.

When the monophase alternating current comes to be applied to the congested terminus of a large railway system, however, these obvious advantages seem to be a little more than offset by practical disadvantages. There is no object in using alternating current except in the readily transformable high voltages desirable for conductor economy; high voltages cannot be safely carried in third-rail or similar conductors, and overhead wires have obvious disadvantages in stations, especially freight stations involving the use of cranes and travelers. The multiplication of switches and side-tracks involves a corresponding multiplication of conductors, which, in the case of overhead conductors, is enormously more costly in proportion, taking into consideration the desirability of making the wires from which current is taken as independent as possible and their supports as few as possible, whereas the third rail can be laid anywhere with equal ease and moved or replaced as readily as a length of running rail.

The theoretically automatic monophase transformer is found to provide a flexibility and safety commensurate with that of the direct-current system only with an attendant at every transformer substation; on the New York, New Haven & Hartford system no transformer stations are used, the generating station voltage being carried directly to the trolley, but, whereas on the New York Central electrification only one man to each 6.2 miles is required continuously to attend the rotary converters, on the New York, New Haven & Hartford system there is an attendant in charge of the sectional cut-out corresponding to each switch-bridge *every two miles*. In either case the duties of the employee permit him to attend to other matters so that the only difference in cost favoring the monophase system is that of the buildings required and the moving machinery of the direct-current converter stations, which rather effectually disposes of the theory that on monophase railways no staff is required for the distribution of traction current.

The number of employees of course decreases with the track congestion, and many miles of monophase trunk line would require only one sectional cut-out attendant, whereas a direct-current trunk-line would still require the converter station and attendant every six miles or so; to offset this, however, there is the immediate probability of the development for large power work of static transformers from alternating to direct current, and their introduction would at once put the direct current upon the same plane as the alternating as regards automatic transmission.

To come to the economy of operation, a New York Central train weighing, say 175 tons with an engine weighing 95, requires in starting from stations and in shunting operations only 400 to 500 amperes at 600 volts; a corresponding New Haven train in getting up speed requires 2,000 amperes and upward at the same voltage, or approximately five times the power, making no allowance for phase displacement, and the motors have the additional disadvantage that running at low speed can only be effected by repeated cutting off and on of the current.

In view of the above considerations, the difficulties of adequately insulating high tension overhead wires in smoky tunnels, of stray magnetic fields, lack of inductive element to counteract surging currents, and not least the electrical possibilities of a serious accident within the electrified zone, which are far more appalling for high-voltage overhead conductors than for any third-rail system under lower voltage, Mr. Uytborck concludes that traffic conditions should be the principal determining factor in deciding upon the system to be used. Electrical engineers, he suggests, have the tendency to follow the latest fashion and to adopt that which is new and has been successful in some instances in preference to older and better-known methods that could sometimes be more economically used.

MANHATTAN SUSPENSION BRIDGE TO BE INVESTIGATED

The last thing that the SCIENTIFIC AMERICAN desires is to pose as an alarmist regarding the safety of public structures; but we must confess to a feeling of relief on learning that the Mayor has directed that the Manhattan suspension bridge be submitted to an expert investigation. Had the recent expert inquiry into the cantilever structure at Blackwell's Island revealed only some minor and easily remedied defects, our confidence in the suspension bridge would not be so rudely assailed; but when we remember that the stresses in some of the members of the cantilever bridge are as high as from 25 to 47 per cent above the limit which has been set by conservative engineering practice, we may be pardoned for feeling no little anxiety as to the actual conditions of things in the Manhattan Bridge. When the present administration came into office, they found on file complete sets of plans for both of these bridges; and one of the first acts of the Bridge Department was to make some very radical changes in these plans. In the case of the cantilever bridge, the live load and the weight of the bridge itself were increased about 25 per cent; although the general outline and plan of the bridge were retained. In the case of the Manhattan Bridge, however, the plans which the Bridge Department found on file were ignored altogether, and others for an entirely different type of structure were drawn up. If, then, a mere change in the loading of the one bridge has sufficed to produce some deplorable results, what may we expect to find in the case of the other structure, in which not even the broad outlines of the original plan were preserved?

In view of these considerations we are gratified to learn that the Mayor has acceded to the request of the City Club for the appointment of "one or more competent bridge engineers to inspect the plans and stress sheets of the Manhattan Bridge," Ralph Modjeski, one of the engineers who will design the new Quebec bridge, having been selected. Anxiety regarding the newer structure is increased by the fact that, although the Bridge Department has from time to time made public the general plans of the Manhattan Bridge, it has never made public the strain sheet. In the course of the investigation of the Blackwell's Island Bridge, the extraordinary fact was developed that no complete strain sheet, showing the stresses in the various members under the heavier loading, was available; and it is natural that a doubt should be raised in the minds of the members of the City Club as to whether any complete strain sheet of the Manhattan Bridge has been drawn up. If approximate methods were adopted in determining the increase of size of the members of the Blackwell's Island Bridge, they may have been used also in proportioning the Manhattan Bridge. It is certain that the only possible way to restore confidence in a suspension bridge, which is not only the largest but the most heavily loaded that has yet been designed or built, was to subject the plans to a searching examination by an independent bridge engineer of national reputation, such as will now take place.

Chinese wood oil is obtained from the nut of the wood oil tree by pressing or extracting. The color of the oil varies with the method of extraction. In China it is usually heated strongly and is consequently very thick and black. Wood oil forms a very durable lacquer for wood, far surpassing boiled linseed oil in hardness and permanence. The oil possesses the peculiarity of drying more quickly in damp than in dry weather. The residue of the nuts left after the removal of the oil is a good fertilizer, which possesses the valuable property of destroying insects which feed on the roots of plants.

ENGINEERING.

The British navy is proverbial for the high speed of its ships. An analysis of this subject shows that there are 26 armored ships exceeding 23 knots in speed, in addition to 16 unarmored ships, chiefly scouts. The list includes 3 armored ships of 24 to 25 knots and 3 of 25 knots and over.

The Brazilian government is planning the construction of about 10 miles of new docks at Rio Janeiro, which, with the two miles already provided for, will give this South American port some 12 miles of new dockage accommodation. The tonnage of the port is rapidly growing, having risen from about one and a half million tons in 1903 to two million tons in 1905.

A recent report by the Board of Trade on the street traffic problem of the city of London estimates it has a population of 7,323,000, residing within an area of 692 square miles. The number of passengers carried in 1907 by local railways, tramways, and buses was 1,281,000,000, and the average number of trips during the same year was 177½ per head of population.

The American Society of Mechanical Engineers has established its first student section by affiliating the Engineering Society of the Stevens Institute of Technology. The latter student organization has an interesting programme of activities for the winter, of which a lecture on "Skyscraper Construction" and the problems it involves was given on December 3 by Mr. C. G. Armstrong, architect of the Singer Building.

An interesting shipment of machinery was recently made, when the Curtis turbines which are being built for the Japanese battleship "Aki" and armored cruiser "Ibuki" left the works of the Fore River Shipbuilding Company for the home dock yards in which the ships are being built. The "Aki" is a 19,750-ton ship carrying four 12-inch, twelve 10-inch, and twelve 6-inch guns, and the "Ibuki" is a 15,000-ton ship mounting four 12's, eights 8's, and fourteen 4.7's.

One of the busiest centers of intersecting street traffic is the crossing at Forty-second Street and Fifth Avenue, New York. To break up the congestion, it is planned to depress Forty-second Street for one-half its width, and carry Fifth Avenue across the street on a viaduct of ornamental construction. Surface cars and heavy vehicles will use the depressed portion of Forty-second Street, while lighter vehicles will use the non-depressed portion crossing Fifth Avenue at street grade.

The advantages of a high-pressure water-supply system as a protection against fire, and as acting to reduce fire risk rates, is being realized in the city of San Francisco, where a substantial cut in the present rates is about to be made by the Fire Insurance Exchange. This action on the part of local fire underwriters is looked upon as a recognition of the security afforded by the new high-pressure system in New York against such conflagrations as have devastated Chicago, Baltimore, and Boston.

The Paris-Orleans Railway has built an unusually powerful compound de Glehn express locomotive, which possesses special interest for Americans because of the fact that it is of the "Pacific" type, which originated in this country and is just at present in great demand for heavy express work. The two high-pressure cylinders are 15⅝ inches, the low-pressure 25 3/16 inches in diameter, and the common stroke 25½ inches. The heating surface is 2,569 square feet, and the total weight of the engine alone about 100 short tons.

We note that Dr. Schlick's apparatus for preventing ships from rolling at sea has lately given fresh proof of its ability. One of his gyroscopes has been fitted on board the mail steamer "Lochiel," and tried on the ship's regular route between Oban and Bunessan. While the vessel was rolling 16½ deg. on each side, through a total angle of 33 deg., the gyroscope was started, and immediately decreased the total angle of roll to 3 deg. The apparatus is driven electrically, and requires but little attention.

The good work done by the Public Service Commission in improving Subway conditions is shown by the recent increase of the capacity of the express tracks by about 14 per cent. This was secured by a rearrangement of the block sections and signals at the stations in such a way that trains can be run closer together, following one another at intervals of 1¾ minutes as against the former interval of 2 minutes. This acceleration has enabled the company to increase the number of cars that pass a given station from 240 to 272 in an hour.

There has recently been completed at Great Falls, Mont., a huge brick chimney for carrying away the fumes of the smelting works, which will take rank as one of the tallest structures in the world. It is 78½ feet in outside diameter at the base, and 53 feet 9 inches at the top. It extends 506 feet above the ground and 528½ feet above its lowest foundation course. Its total weight is 24,964 tons. The brickwork is 18 inches in thickness at the top and 66 inches at the base. It is lined throughout with a 4-inch wall of acid-proof brick.

ELECTRICITY.

The Bureau of Equipment will open bids on January 5 for the long-distance high-power wireless station which, as was recently announced, is to be located near Washington. The station must transmit messages over a radius of 3,000 miles and must also be equipped with a telephone system sending to a distance of 100 miles.

In some experiments with a kite to determine the electrical conditions of the upper atmosphere, it has been found that an abnormally strong current will flow down the wire during a high wind. The cause of this has not definitely been determined. Two reasons have been suggested; namely, that the action of the wind would tend to cause a greater electrification by friction, or that the greater volume of air passing over the kite would supply greater surface from which to collect the electricity of the atmosphere.

A method of making glass which will conduct electricity is described in a paper read before the Royal Society of Edinburgh by Charles S. Phillips. The glass consists of 32 parts sodium silicate, 5 parts borax, 0.8 part lead oxide, and 0.2 part sodium antimoniate. This glass is not acted upon by acids, and has a resistance of about 1,000 times less than that of ordinary glass. It is used for the windows of electrometers and electroscopes, and in the latter instrument fibers of the glass have been used in place of the gold leaves.

The proposed tax on electricity in Germany is still receiving a great deal of criticism. The tax is to be levied on filament lamps in proportion to their watt consumption, and it has been pointed out that carbon filament lamps will be taxed to nearly 60 per cent of their market price, while metal filament lamps will be taxed only 9 per cent of their market price. Arc lamps are to be taxed according to the weight of the carbons, which is manifestly unjust, for the quality of the carbons should be considered rather than their weight.

The French Academy of Science is somewhat puzzled over the question of the influence exerted by a high-tension line on hailstorms. In a recent paper presented before the Academy the instance was cited of a chain of mountains which apparently attracted hailstorms, owing to the location of numerous valleys that diverted the storms along the line of the chain. Recently, a three-phase 45,000-volt line was built in this vicinity, and since then hailstorms have crossed the valleys and followed the high-tension line. Very evidently the transmission line exerted an influence on the storms, but the exact nature of this influence is difficult to explain.

After building several experimental single-phase locomotives and thoroughly trying them out with various trolley constructions over an experimental five-mile track, equipped with various forms of trolley constructions, the Pennsylvania Railroad has decided to adopt a third rail direct-current system for its tunnels under New York city. Three-phase twenty-five cycle current will be supplied at 11,000 volts from Long Island City, and at various sub-stations it will be converted into 600 volts direct-current. Steel motor cars and trailers will be used for the suburban traffic, while electric locomotives will be used for through trains. The design of these locomotives has not as yet been definitely decided upon.

A train staff system similar to that used in England, has been adopted on the Fort Wayne Division of the Ohio Electric Railway. The cars incoming and outgoing are required to pass each other at a switch on the outskirts of Fort Wayne, but owing to the fact that the cars pass through different streets in the city, and are not always liable to come in sight of each other, it was found necessary to provide some system whereby the arrival of the car at the switch could be definitely determined. For this reason a wire hoop with train numbers on tags attached thereto is given to the motorman at New Haven, and this he deposits at the siding at Fort Wayne, so that the car returning from Fort Wayne will know that his car has entered the city.

The advantages of small electrically driven refrigerating plants were discussed before the Franklin Institute last month. One rather interesting installation described was set up in a florist's shop. A large display case embracing about 500 cubic feet, was refrigerated by means of from 500 to 700 pounds of ice per day, this large amount being required by reason of the fact that the case was frequently opened during the day. A small electrical refrigerating machine of one ton capacity has now been installed and this serves to freeze a solution of brine contained in four tanks. The brine solution is very weak and has a freezing point of about 26 deg. F. The tanks are frozen solid each morning, and the machine is not operated again until toward evening. The system has been found to work admirably even though the door is constantly opened and the temperature may rise at times as high as 60 deg.

SCIENCE.

Prof. Percival Lowell announces that spectroscopic proof has been obtained of the presence of water on Mars. This would seem to settle once and for all a moot Martian question in Lowell's favor.

F. von Strants has obtained a German patent for a process of destroying insects on plants by the application of a mixture of lime water and the ammoniacal liquor of gas works. The patentee states that neither lime nor ammonia, used alone, is a certain insecticide in dilute solution, and that strong solutions are injurious to plants, especially green plants, but that mixed solutions of the two alkalies, too weak to do any damage to the plant, infallibly destroy all insect parasites.

The part played by sedimentation basins, or septic trenches, in the bacteriological purification of sewage is much disputed. Some writers assert that the basins serve only to retain part of the suspended matter, so that a less turbid liquid can be decanted which will clog the bacterial filter beds less rapidly than crude sewage, while other and more numerous authorities hold that a large proportion of the organic matter is decomposed, dissolved, and volatilized in the basins. Prof. Calmette, in a recent paper, shows the importance of this disintegrating action, which results in the solution of from 30 to 50 per cent of the organic matter originally held in suspension. Experience proves, furthermore, that the matter which is not thus decomposed is little subject to putrefaction, or that the sediment left in the basins has very little odor, can be handled without inconvenience and may safely be thrown, in small quantities, into large running streams.

A new watch has been invented for the use of physicians and nurses in counting the pulse. The watch indicates, without mental calculation, the number of beats of the pulse in a minute. It operates on the principle of a stop-watch. By pressing the push-button a large second hand is set in motion, and the counting of the pulsations begins. At the 20th pulsation the motion of the hand is stopped by another pressure of the push-button. The dial accurately indicates the exact number of pulsations per minute. A third pressure on the push-button brings the hand back to the starting point. The use of this instrument does away with the necessity of observing the progress of the watch while taking the pulse, and in addition insures an absolutely correct record. The instrument is also a chronographic counter, facilitating the making of observations, which are automatically recorded in minutes, seconds and fifths of a second. A small dial placed below the 12 records minutes from 0 to 30. The large hand records seconds and fifths of a second.

M. Pleissner, of the German Imperial Health Bureau, has investigated the formation and properties of the oxide, hydroxide, carbonate, sulphate, and chloride of lead, and has determined their solubilities in water by measuring the electrical conductivity of water impregnated with them. He finds that alkalies and baryta water precipitate the oxide from hot solutions, but the hydrated oxide from cold solutions of lead salts. The oxide forms grayish yellow scales of metallic luster, which yield a greenish yellow powder when ground. The same greenish yellow oxide is formed by the action of very highly oxygenated water upon lead, while water which contains little oxygen produces hydrates of lead oxide. The solubility of lead oxide increases with the degree to which it is hydrated. The solubilities of the lead compounds mentioned above expressed in milligramme-molecules per liter, are: oxide 0.31, hydroxide 0.45, carbonate 0.0002, sulphate 0.126, chloride 33.6. In other words, one million parts of water can dissolve about 64 parts oxide, 93 parts hydroxide, 0.04 part carbonate, 26 parts sulphate, or 7,000 parts of chloride of lead. All of the basic salts of lead are less soluble than corresponding neutral salts.

That the smoke which rises from the chimneys of a city in winter greatly diminishes the practical duration of sunlight is shown by a comparison of observations made in the center of London, at Kew, a few miles to the west, and at Greenwich, a few miles to the east. The annual number of hours of sunshine is at Kew 1,399 or 31 per cent of the maximum possible number; at the center of London, 1,027 hours or 23 per cent, and at Greenwich 1,22[illegible] or 27 per cent. Hence the center of London enjoys 372 hours (8 per cent) of sunshine less than Kew, and 200 (4 per cent) less than Greenwich. In winter the deficiency of sunshine in the center of London rises to 11 per cent. The disparity between Kew and Greenwich is due to the fact that the prevailing winds are westerly, so that much of the city's smoke is blown over Greenwich, but very little over Kew. At Hamburg, observations extending over eleven years show an average annual number of 108 days without sunshine. At all seasons, but especially in winter, the air of Hamburg is filled with smaller or larger particles of soot. The result is that Hamburg annually enjoys only 1,236 hours of sunshine, or 28 per cent of the maximum possible number, while Berlin enjoys 1,672 hours or 37 per cent.

THE TRANSPORTATION OF SUBMARINES.

BY F. A. HISLAM.

In the latter part of 1906 the Japanese government placed an order with the British firm of Vickers, Sons & Maxim for the construction of two submarines, the conditions of the contract stipulating that the vessels should be delivered at a Japanese port before the close of the present year. The submarines are vessels with a submerged displacement of 314 tons. They are 135 feet long, 13 feet 6 inches beam, and 12 feet deep, and are fitted with 16-cylinder gasoline engines, the horsepower being 600 on the surface and 180 submerged. The corresponding speeds are 13 and 8 knots. The armament consists of two 18-inch torpedo tubes, and sufficient fuel is carried to give the vessels a radius of 1,500 miles.

In order to overcome the difficulty of transporting the vessels to Japan, Messrs. Vickers, Sons & Maxim designed and built a transporter of unique type. The vessel, which is 225 feet long, is constructed with a very short forecastle, while the engines are placed as far aft as possible, thus leaving a very large clear space amidships. The break of the poop is also the fore engine-room bulkhead, and a wide hatchway extends forward from this practically to the break of the forecastle. The athwartship hatchway beams are removable, so as to admit an object almost the entire length of the hold. There is, of course, a very large number of these beams, and they are made especially strong, in order to compensate for the huge deck opening.

The method by which the submarines were placed on board was as follows: The "Transporter," as the vessel is named, was drydocked, the port bulwark taken down, the hatch combing on the same side removed, and a portion of the steel deck taken up. The water was then admitted to the dock, totally submerging the hull with the exception of the upper portion aft. One of the submarines was then floated into the dock, hauled into position over the hold of the submerged ship, and held there while the water was pumped out of the dock. As the submarine sank into the hold, it was placed in specially arranged chocks by divers, and finally secured in position on the starboard side of the hold. This operation was then repeated in the case of the second submarine, so that eventually the two vessels lay side by side in the hold of the "Transporter." The decks, hatch combings, and bulwarks were then replaced, and the vessel afterward returned to Barrow to complete the preparations for her voyage to the far East. With their arrival the Japanese navy will include ten submarines, two of which, of 85 tons, were built in Japan. Seven other vessels, of the same size as those built in England, are about to be laid down in Japanese yards.

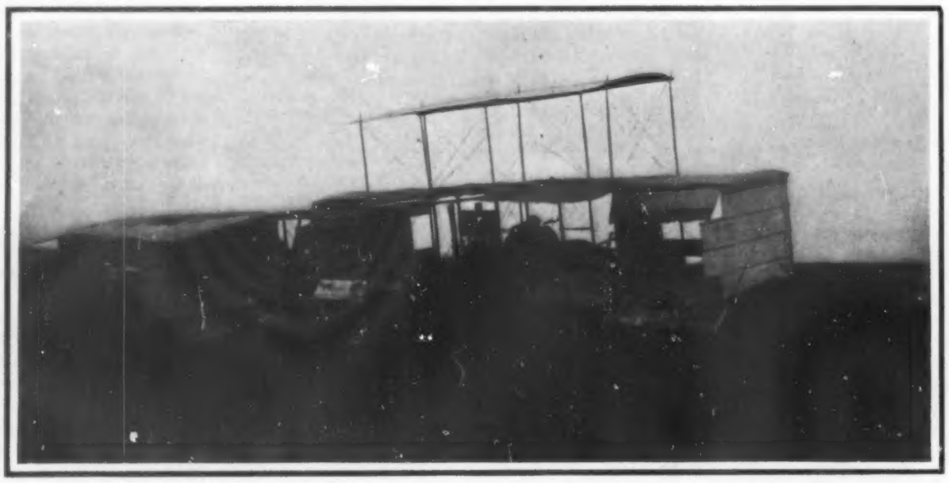
The photograph shows the submarine on the port side sinking into the hold of the "Transporter."

FLOATING A SUBMARINE INTO A VESSEL FOR TRANSPORTATION.

FARMAN'S EXPERIMENTS WITH HIS TRIPLE-SURFACE AEROPLANE.

By the addition of a third surface to his aeroplane Henry Farman has recently changed the appearance of his flyer somewhat, and has made it capable of lifting considerably more weight. The third plane, as can be seen from our photograph, extends only over about two-thirds of the total width of the lower surfaces. In addition to this plane, Farman has also lengthened the top surface of the box tail, so that the sides now extend beyond the vertical partitions.

On the 21st ult., Farman expected to give a demonstration before some Senators and members of the National Aerial League who had journeyed from Paris to his experimental ground at Bouy, near Reims. Unfortunately, there was a strong wind blowing and Farman did not dare to make a flight until this had moderated. Finally, at dusk, he made two short flights lasting about two and four minutes, respectively. In the second of these flights he circled twice around the parade ground. He had fitted automobile acetylene headlights to his aeroplane, and the effect of the machine flying at night is said to have been very weird.



THREE-QUARTER REAR VIEW OF FARMAN'S AEROPLANE WITH TRIPLE SURFACES.

Note the extension out at the sides of the upper surface of the box tail; also the hinged flaps on the rear edges of the main surfaces.

Not until the 24th of November had the weather improved sufficiently for Farman to make a demonstration. Even on this day there was a strong wind of from 6 to 14 meters per second or having a mean speed of 21¾ miles an hour. Despite this wind Farman flew successfully, though the sudden puffs would raise and lower his machine suddenly a distance of from 45 to 60 feet. The oscillations thus produced were very curious. Farman was obliged to fly quite high in order to take the turns successfully. When he flew with the wind his aeroplane traveled at the rate of about 55 miles an hour, while against the wind it almost stood still. These flights are the first in a closed circuit by this type of machine. The aeroplane showed such a marked improvement in stability when flying in a strong wind, that Farman, although he found in a subsequent test on November 28 that the machine was much faster with but two surfaces, nevertheless decided to return to the use of three.

Aeronautical Notes.

WILBUR WRIGHT'S NEW RECORD.

On Friday, December 18, Wilbur Wright improved by 22 minutes and 8 seconds his previous record of September 21, for length of time in the air. On this occasion he made forty-five complete circuits of the Anvours parade ground at an average height of 24 feet and at an average speed of about 36 miles an hour. The total official distance was 99 kilometers (61.47 miles), but on account of the wide turns he made around the posts at the ends of the field, it is estimated that fully 120 kilometers (74.52 miles) were covered. The latter distance gives an average speed for the flight of 39.2 miles an hour, and the former one of but 32.4. The average of these two speeds—35.8—doubtless gives a fair approximation of the actual speed of the machine. For a motor of but 25 to 30 horse-power, this is a very high average, and it forms but one more demonstration of the efficiency of the Wright aeroplane. After making this record flight for the Michelin cup in the morning, Mr. Wright in the afternoon competed successfully for the height prize of the Aero Club of the Sarthe. A line of small captive balloons was placed at a height of 100 meters (328 feet), and, after making a 9-minute flight, the aeroplane passed over the line at a height of some 25 or 30 feet above it.

FLIGHTS OF THE "SILVER DART."

The new Bell aeroplane the "Silver Dart," after making four short flights on the 14th instant, on December 17 made a flight of over a mile at Hammondsport, N. Y. The aeroplane flew in a snowstorm and against a wind of about 10 miles an hour at the start. After traversing a distance of less than a mile, a turn was made and the machine flew successfully with the wind about half way back to the starting point. The flight lasted 1¼ minutes and the estimated speed was about 40 miles an hour.

Two days previously Mr. Wright made a new demonstration of the possibilities of his aeroplane when used as a glider. He drove his machine sharply upward to a height of nearly 300 feet. Then, shutting off the motor, he glided down to the ground very easily. In so doing he traversed a distance of about three-quarters of a mile. This demonstration proved the advantage of height when navigating an aeroplane and gave a good idea of the distance that can be traversed in a horizontal direction should the motor stop when the aeroplane is high in the air.

A German company has recently been formed to carry on the aerial transportation of passengers, by means of huge airships of the Zeppelin type. Seven of these airships, with a capacity of ten passengers each, in addition to the crew, have been ordered, and are now under construction. The airships will start from Friedrichshafen, on Lake Constance, and touch at many of the leading German cities.

MODELS FOR ILLUSTRATING THE STRAIN ON STRUCTURES.

BY DR. ALFRED GRADENWITZ.

There is hardly any doubt that the value of mathematical formulæ to constructing engineers is frequently overrated. In fact, even in connection with the most complicated construction of a statically undetermined nature a figure calculated on a given basis is frequently considered as an absolute gage of safety.

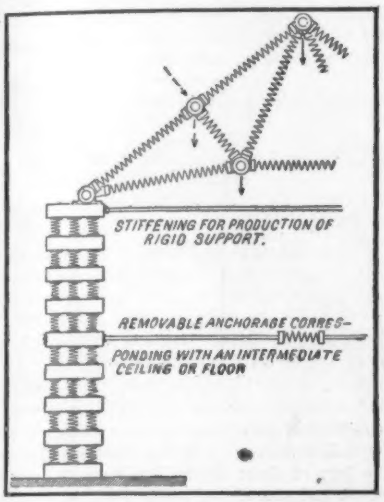


Fig. 6.—Showing interrelation of strains on various parts of a structure.

Even if all factors determining the distribution of strains in a given structure could be reduced to a mathematically available form, it should be considered that statical calculations are possible only for a given condition of the structure, being liable to alteration as a consequence of any elastic or non-elastic change in the shape of some part of the structure, or of its abutments.

The distribution of strains in an arch free from any joints may, for instance, very well be calculated mathematically with a practically sufficient degree of accuracy for a given load, if the abutment be invariably rigid, or if the displacement or distortion be known. However, there are in reality no invariably rigid abutments, while the displacement and torsion generally depend on so many factors, that mathematical calculations fail to determine them. Starting from the results of a statical calculation for a given condition, any possible departures from the hypotheses made, and their possible influence on the distribution and magnitude of actual strains, should accordingly be gaged in each case.

The influence of these factors should by no means be underrated, being sometimes so considerable, that the results of calculation afford an entirely incorrect representation of the conditions of safety of a structure. Another striking instance is that of framed structures in which the rigidity of webs is liable to entirely impair the results of mathematical calculation, in connection with which hinged connections are generally pre-supposed. In order, therefore, to supply an independent check on mathematical instruction, based on practical experience, Mr. E. Carlipp of Erlangen, Germany, has designed an ingenious device for illustrating the distribution of strains in structures, of which we herewith give a short illustrated description, as well as some photographs.

Any structure under the action of forces (provided that no motion of the whole takes place as a consequence of a rupture in equilibrium) is liable to undergo some alteration in shape, which at each point bears a certain ratio to the strain obtaining there. If this alteration in shape be known, the distribution of strains will thus be likewise given.

The models used by Carlipp are made up alternately of springs and rigid sections (see Fig. 1) in order to allow the actual alterations in shape and strain to be visually observed. Any kind of forces (such as pull, thrust, inflection, torsion, rotation) will produce in a composite body of this kind, alterations in shape, which allow the nature and relative magnitudes of strains to be recognized. The strength of the springs corresponds to the coefficient of elasticity of the material; and by fitting springs of variable strength, the distribution of strains on a structure, made of different materials, is readily illustrated.

The strains on the springs f_1 (in Fig. 1), for instance, will be the smaller the less the springs f_1 are able to yield, that is the greater the amount of load they are able to deal with. The same instance also corresponds to cases in which the coefficient of elasticity in regard to thrust is greater than elasticity in regard to pull. The points of maximum strain in many cases play an essentially important part.

If the model be lined with paper, plaster, etc. (Fig. 2), the fissures resulting from given conditions of load and given arrangements of abutments will allow their location to be determined, while illustrating the relative amounts of strain in a specially striking manner, corresponding to real life. In the case of framework structures, the framework rods are generally formed by simple continuous springs connected by joints in the connections. These joints may be fixed by clamps with a view to illustrating the influence of rigidity of the webs. The various elements can be combined in many different ways, so as to obtain the most varied models suitable for instruction. Though all possible cases cannot obviously be enumerated in the present article, some instances will be quoted, illustrating the possibilities of these mod-

Fig. 7.—Diagram of arch with sliding abutment.

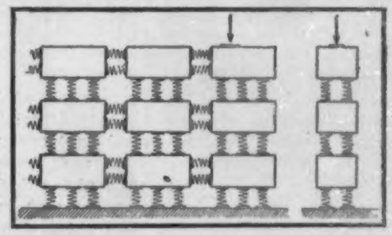


Fig. 8.—Distribution of loads inside a structure.

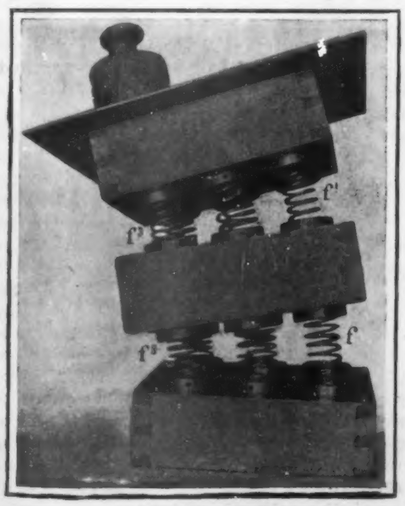


Fig. 1.—Composite model of springs and rigid sections.

Fig. 2.—Model showing strains by the fissures in the paper covering.

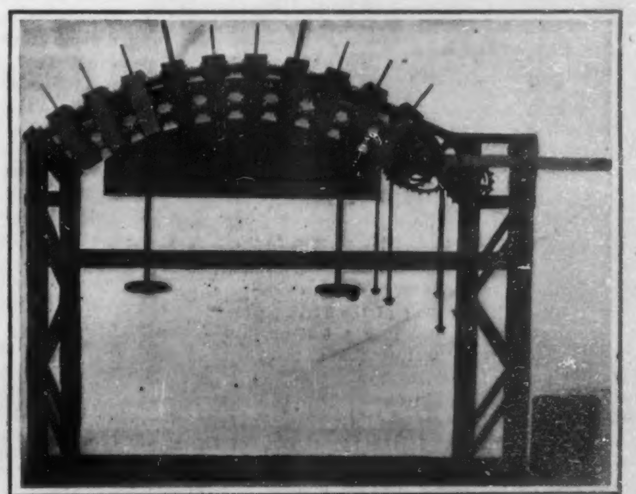


Fig. 3.—Arch supported while being loaded.

Fig. 4.—Arch under load, showing breaks at crown and abutments.

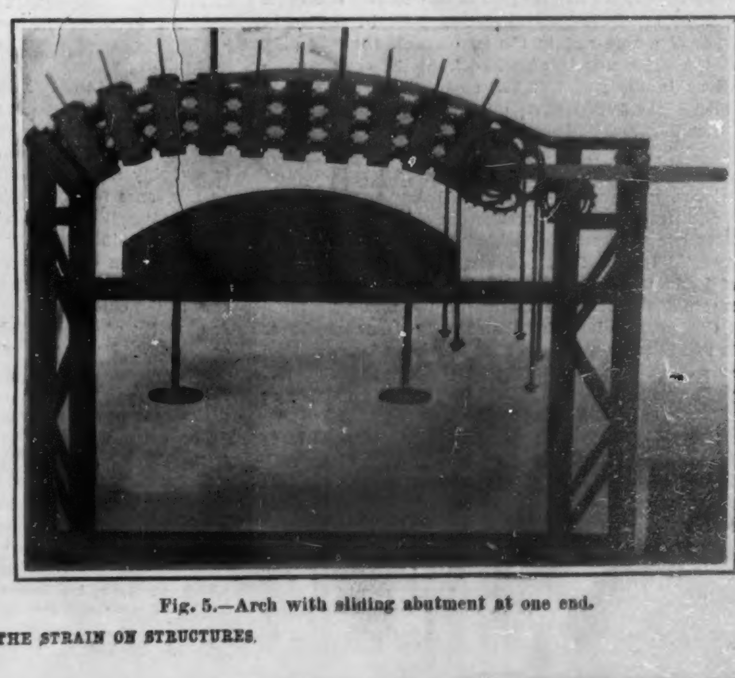


Fig. 5.—Arch with sliding abutment at one end.

MODELS FOR ILLUSTRATING THE STRAIN ON STRUCTURES.

els, both for demonstration before an auditorium and for self-instruction.

Fig. 5 represents a model in which the distribution of strains in an arch is illustrated for different loads, and with different abutments, one of the abutments being free to rotate round an axle and to move in a horizontal direction. This horizontal motion can be counteracted by the weight *H* (Fig. 7), and the rotation by the weight *G*; the former thus representing the horizontal thrust and *G* the torque of the abutment. Both the horizontal displacement and rotation can be completely eliminated by arresting the abutment with the aid of suitable weights. Demonstration with this model could, for instance, be performed in the following manner:

The arch is first supported by a simple center liable to be lowered, while being loaded either by its own weight alone, or by an additional effective load of approximately uniform distribution (Fig. 3), thus illustrating the fact that all springs are by no means compressed uniformly, a lined arch being liable under certain conditions even to show some fissures; though with the actual shape and load of the arch there may be ascertained a curve of pressures which practically coincides with the central line of the arch.

It may even be shown that any moments of deflection obtaining in the arch (that is, any departures of the line of pressure from the central line) are mainly due to the elastic shortening of the arch, these moments being the greater as the ratio of the thickness of the arch to the pitch is greater, any arch in connection with which this ratio does not assume too small a value, being in reality something intermediary between an arch and an imbedded girder, and the girder action being the more predominant as the shape of the arch approximates that of a girder. If now a sufficient amount of weight be added in *H*, to prevent any displacement of the abutment, the stop being loosened, *H* will correspond to the horizontal thrust after an elastic elongation of the arch in the case of rigid abutments. By shortening the arch, an identical effect to an increase in the distance of abutments will be brought about. By increasing *H*, the abutments can be made to approach to one or other, the elastic shortening of the arch being compensated and uniform strains being produced in all the sections of the arch. It is also seen that the horizontal thrust decreases with the elastic elongation of the arch. It will now be readily understood in what manner the influence of the yielding of abutments can be illustrated: Each given weight *H* and *G*, the load remaining the same, will correspond to a given displacement or distortion, and the latter in turn will influence in a given manner the distribution of strains in the arch. In the case of a lined arch (Fig. 4) fissures can be produced, with a given load, at the crown, at will, either on the top or below, by simply increasing or decreasing *H*. The influence of the most different loads can likewise be shown for the most varied arrangements of abutments, and the influence of transverse forces is readily illustrated by the relative displacement of the rigid parts.

The model represented in Fig. 6 is mainly intended for illustrating the fact that a structure, from the statical point of view, always exerts its effects as a whole, the actual strain on any part of the structure being dependent on those to which the remaining parts are submitted. If the upper parts of the supports (walls) be solidly reinforced, the roof structure will rest on abutments, capable of only relative displacement, and according as the joints are hinged or clamped fast, a given distribution of strains will be obtained with a given load. The distribution of strains will be susceptible to alteration both in the main truss of a roof and in the supports, if the stiffening of the abutments being withdrawn, the elastic alterations in the shape of the supports are allowed to make themselves felt.

Another model designed by Mr. Carlipp is represented in Fig. 8. When calculating a structure, the section of which has sides of different length (walls, bridges, girders, etc.), the load being approximately concentrated, incorrect results are obtained if the sections are supposed to remain plane. The model represented in Fig. 8 now illustrates with a given drop of loads, the distribution of strains inside the structure and the pressure exerted on the soil.

Girders, etc., in which the effect of transverse forces is manifested separately, that is to say, by a vertical as well as by a horizontal mutual displacement of the rigid parts, can be combined in a similar manner to that illustrated in Fig. 8.

Even in cases which are not at all susceptible to calculation, such as that of plates resting on non-uniform abutments (e. g., triple abutments) such a model will allow the distribution of forces to be ascertained for any load.

Simple girders can be constructed in a manner quite similar to the arch in Figs. 5 and 7, being demonstrated for the most various arrangements of abutments (isolated on two abutments wholly or partly imbedded, continually resting on supports of equal or unequal height) and under any conditions of load.

While all the possible cases cannot obviously be demonstrated in the case of technical instruction, even a limited number of demonstrations will doubtless fit students to acquire an appropriate conception of the phenomena of elasticity obtaining in connection with real buildings, instead of being content with mechanical calculation. Teachers will be able to use such demonstrations as a basis of general instruction of a kind which is apt to be neglected in the ordinary theoretically mathematical courses, while even advanced students will avail themselves of certain models to complete their knowledge of the statical conditions of structures. It will even be possible to construct models immediately imitating a given structure to be erected, so as to afford an absolutely correct gage of the actual distribution of strains.

In order to illustrate the distribution of stresses in homogeneous bodies, all the springs should obviously be of the same thickness, being submitted to the same strain. In order to allow this result to be readily obtained, the springs are connected with the rigid parts, by a simple device, allowing the springs to be tightened or loosened, or even exchanged at a moment's notice.

MAGNITUDE OF THE SALT INDUSTRY.

Sodium chloride or common salt is one of the most useful substances in the world and one of the most necessary to the human economy. Salt was first used as an aliment at the period of transition from the nomadic pastoral life to a more sedentary and agricultural life. Salt puts in motion the secretion of the stomach and furnishes it with some of its constituent parts. The material for the chlorine compounds of the gastric juice comes primarily from the salt of our food.

In any attempt to compute the relative abundance of the chemical elements we must bear in mind the limitations of our experience. Our knowledge of terrestrial matter extends but a short distance below the surface of the earth, and beyond that we can only indulge in speculation. The atmosphere, the ocean, and a thin shell of solids are, speaking broadly, all that we can examine. For the first two layers our information is reasonably good, and their masses are approximately determined; but for the last one we must assume some arbitrary limit. The real thickness of the lithosphere need not be considered; but it seems probable that to a depth of 10 miles below sea level the rocky material can not vary greatly from the volcanic outflows which we recognize at the surface. This thickness of 10 miles, then, represents known matter, and gives us a quantitative basis for study. A shell only 6 miles thick would barely clear the lowest deeps of the ocean.

The volume of the 10-mile rocky crust, including the mean elevation of the continents above the sea, is 1,633,000,000 cubic miles, and to this material we may assign a mean density not lower than 2.5 nor much higher than 2.7. The volume of the ocean is put at 302,000,000 cubic miles, and Prof. Frank Wigglesworth Clarke in his valuable "Data of Geochemistry," says he has given it a density of 1.03, which is a trifle too high. The mass of the atmosphere, so far as it can be determined, is equivalent to that of 1,268,000 cubic miles of water, the unit of density. Combining these data, we get the following expression for the composition of the known matter of our globe:

Density of crust		2.5	2.7
Atmosphere	per cent	0.03	0.03
Ocean	per cent	7.08	6.58
Solid crust	per cent	92.89	93.39
		100.00	100.00

In short, we can regard the surface layer of the earth, to a depth of 10 miles, as consisting very nearly of 93 per cent solid and 7 per cent liquid matter, treating the atmosphere as a small correction to be applied when needed. The figure thus assigned to the ocean is probably a little too high, but its adoption makes an allowance for the fresh waters of the globe, which are too small in amount to be estimable directly. Their insignificance may be inferred from the fact that a section of the 10-mile crust having the surface area of the United States represents only about 1.5 per cent of the entire mass of matter under consideration. A quantity of water equivalent to 1 per cent of the ocean, or 0.07 per cent of the matter now under consideration, would cover all the land areas of the globe to the depth of 290 feet. Even the mass of Lake Superior thus becomes a negligible quantity.

The composition of the ocean is easily determined from the data given by Dittmar in the report of the "Challenger" expedition. The maximum salinity observed by him amounted to 37.37 grammes of salts in a kilogramme of water, and by taking this figure instead of a lower average value we can allow for saline masses inclosed within the solid crust of the earth, and which would not otherwise appear in the final estimates. Combining this datum with Dittmar's figures for the average composition of the oceanic salts, we get the second of the subjoined columns. Other elements contained in sea water, but only in minute traces, need not be considered here. No one of them could reach 0.001 per cent.

Composition of oceanic salts.		Composition of ocean.	
		O	85.79
NaCl	77.76	H	10.67
$MgCl_2$	10.88	Cl	2.07
$MgSO_4$	4.74	Na	1.14
$CaSO_4$	3.60	Mg	.14
K_2SO_4	2.46	Ca	.05
$MgBr_2$	.22	K	.04
$CaCO_3$	.34	S	.09
		Br	.008
	100.00	C	.002
			100.00

It is worth while at this point to consider how large a mass of matter these oceanic salts represent. The average salinity of the ocean is not far from 3.5 per cent; its mean density is 1.027, and its volume is 302,000,000 cubic miles. The specific gravity of the salts, as nearly as can be computed, is 2.25. From these data it can be shown that the volume of the saline matter in the ocean is a little more than 4,800,000 cubic miles, or enough to cover the entire surface of the United States, excluding Alaska, 1.6 miles deep. In the face of these figures, the beds of rock salt at Stassfurt and elsewhere, which seem so enormous at close range, become absolutely trivial. The allowance made for them by using the maximum salinity of the ocean instead of the average is more than sufficient, for it gives them a total volume of 325,000 cubic miles. That is, the data used for computing the average composition of the ocean and its average significance as a part of all terrestrial matter are maxima, and therefore tend to compensate for the omission of factors which could not well be estimated directly.

The facts that we can estimate, with a fair approach to exactness, the absolute amount of sodium in the sea, and that it is added in a presumably constant manner without serious losses, have led to various attempts toward using its quantity in geological statistics. The sodium of the ocean seems to offer us a quantitative datum from which we can reason. That is, if all the sodium in the sea were derived from the decomposition of igneous rocks, a shell of the latter one-third of a mile thick would supply the entire amount. An allowance for the sodium retained by the sedimentaries would increase this estimate to half a mile, which is the largest amount possible. All conceivable corrections tend to diminish the figure. A stratum of igneous rock, one-half mile thick and completely enveloping the globe, would furnish all the sodium of the ocean and the sediments. Joly, by a similar process of reasoning and in part from the same data, has sought to compute the geological age of the earth since erosion commenced. From Murray's estimate concerning the discharge of rivers Joly determines that 157,267,544 tons of sodium are annually poured into the sea. At this rate denudation of the land would require a period of from ninety to one hundred millions of years in order to make up the oceanic quantity of sodium. By applying certain corrections the figure is reduced to eighty or ninety millions of years as the time which has elapsed since water condensed upon the globe and aqueous denudation began.

It is not necessary to enter into the details of these and other similar calculations, for they can only be regarded as tentative and preliminary. They do, however, indicate certain possibilities and show how desirable it is that we should increase the accuracy of our data. When we know more precisely what chemical work is being done by the rivers, with annual averages for all of the greater continental streams, we may have materials for something like a fair measure of geological time. Our present knowledge on this subject is too incomplete and too unsatisfactory.

In 1907 the quantity of salt produced in the United States was 29,704,128 barrels of 280 pounds, valued at $7,439,551, says W. C. Phalen, expert of the Geological Survey.

For convenience salt is classified according to the grades by which it is sold by the producer, the grades being determined by the amount of refining, the methods employed in refining, and the purposes for which the salt is used. These grades are: "Table and dairy," "common fine," "common coarse," "packers," "solar," "rock," "milling," "brine," and "other grades." The "table and dairy" salt includes extra fine and fancy grades prepared for family use, and all grades artificially dried, used for butter and cheese making and such special brands. Under "common fine" salt are included all other grades of fine salt of first quality not artificially dried, such as those known to the trade as "C. F.," "No. 1 F," "anthracite," etc. "Common coarse" salt includes all grades coarser than "common fine" made by artificial heat, such as "steam coarse," "No. 1 coarse," "pan solar," "G. A.," "Liverpool ground," "C. C.," etc. By "packers" salt is meant those

grades prepared for the purpose of curing fish, meats, etc. "Coarse solar" includes all coarse salt made by solar evaporation. "Rock" salt includes all salt mined and shipped without special preparation. "Mill" salt is that used in gold and silver mills, and "other grades" includes all low-grade or No. 2 salt used in salting cattle and for fertilizers, track purposes, etc. "Brine" includes all salt liquor used in the manufacture of soda ash, sodium bicarbonate, sodium hydrate (caustic soda), and other sodium salts or brine sold without being evaporated to dryness.

Production of salt by grades in the United States 1907, in barrels:

Table and dairy salt	3,537,157
Common fine salt	7,684,638
Common coarse salt	2,055,054
Packers salt	422,324
Solar salt	862,029
Rock salt	5,809,328
Other grades	110,227
Brine	9,222,471
Total production, barrels	29,704,128
Value	$7,439,551

In 1894 salt was placed on the free list and importations increased to 434,155,708 pounds in 1894 and to 520,411,822 pounds in 1896. In 1897 salt was again made dutiable, and salt in bags, barrels, or other packages is subject to a duty of 12 cents per 100 pounds (33.6 cents per barrel) and salt in bulk is taxed 8 cents per 100 pounds (22.4 cents per barrel). The duty on imported salt in bond used in curing fish taken by licensed vessels engaged in fishing and in curing fish on the navigable waters of the United States or on salt used in curing meats for export may be remitted.

The imports came from the United Kingdom, Italy, British West Indies, and Spain, named in the order of importance. From these four sources over 90 per cent of both quantity and value of the imports were derived.

The exports of salt of domestic production from the United States in 1907 was 61,603,422 pounds, valued at $232,195. Most of this salt went to Cuba, Canada, Mexico, and Panama.

In the following table the statistics of salt production in the principal salt-producing countries of the world in 1906 are shown as far as statistics are available. The production of Turkey is not included. The industry in that country, as in Austria-Hungary, is a government monopoly, with no statistics of production published. No statistics are available from Russia since 1903.

World's Production in Short Tons.

		Quantity.	Value.
1906.	United States	3,944,133	$6,658,350
1906.	United Kingdom	2,201,293	2,900,983
1906.	France	1,496,923	4,198,329
1906.	German Empire	2,059,096	5,000,823
1904.	Japan	773,776	4,852,049
1906.	Italy	586,424	1,119,786
1906.	Austria	414,465	9,717,164

Our graphical illustrations really explain themselves. Thus our upper engraving shows all the salt of the oceans thrown up on the land and sea, it would cover the entire earth to a depth of 112 feet or well above the roof of the Capitol at Washington. The next comparison shows the *per capita* consumption of the Frenchman 9 pounds, the Englishman 13 pounds, and the American 11 pounds. Then follow the two cones of salt, that in the sea 4,800,000 cubic miles and 325,000 cubic miles for salt on the land. Little wonder that Mont Blanc appears as a mere speck. The last comparison is the yearly production of salt in the United States, which shows a tidy little barrel 700 feet high and 500 feet in diameter at its widest point. Truly the small condiment of our table presents an enormous mass in the aggregate.

In the rebuilding of the Quebec Bridge, it is said that the engineers who have been retained by the Dominion government will consider the advisability of providing for at least ten feet more headroom from the water than existed under the former structure. It may be remembered that the height of the old Quebec Bridge was 150 feet above high water, and that the Montreal Board of Trade feared that this would prevent the large ships of the future from passing up the river to Montreal. The height advocated by the Montreal Board of Trade was 190 feet, which, however, can only be obtained at a cost which is regarded as prohibitory. The tallest masts now arriving in Montreal are those of the Allan liner "Virginian," which are of a height of 141 feet. Under the old Quebec Bridge these would have passed with nine feet to spare. But the masts of the "Empress of Britain" and the "Empress of Ireland," of the Canadian Pacific line, are 154 feet high, and for these it would have been necessary to await the ebb of the tide if they wished to pass under.

Correspondence.

CURIOUS FACTS ABOUT NUMBERS.

To the Editor of the SCIENTIFIC AMERICAN:

The theorems given in the article on "More Curious Facts About Numbers" in last week's issue of the SCIENTIFIC AMERICAN are not new, but merely special cases of Fermat's theorem. This well-known proposition is usually stated: If p is a prime number, and x is any integer, *not a multiple* of p, then $x^{p-1}=1$ (mod. p), or

$$x^{p-1}-1 \text{ is divisible by } p. \qquad (1)$$

it easily follows that for *any* integral value of x

$$x^{p}-x \text{ is divisible by } p. \qquad (2)$$

For $x^p-x=x(x^{p-1}-1)$, and either the first or the second factor of the right member is divisible by p. (Throughout these deductions p is supposed to represent a prime number.)

In regard to divisibility, the writer of the "Curious Facts about Numbers" obtained three results, viz.:

1. x^7-x is divisible by 7, and $x^{13}-x$ is divisible by 13.
2. $x^{13}-x$ is divisible by 2, 5, 7, and 13.
3. Either x^5+1 or x^5-1 is divisible by 11.

The first results represent simply two special cases of (2), viz., the cases $p=7$, and $p=13$, but (2) is true for any other prime value of p. Thus, numbers of the form x^2-x can be divided by 2, those of the form x^3-x by 3, x^5-x by 5, etc. Or, to illustrate concretely: $2^{17}-2$ can be divided by 17, $11^{37}-11$ by 37, etc.

The second result can be deduced by factoring $x^{13}-x$.

$x^{13}-x=x(x^6-1)(x^6+1)$, and $x(x^6-1)$ is a multiple of 7, hence $x^{13}-x$ is a multiple of 7. Similarly, by considering that $x(x^4-1)$, $x(x^2-1)$, and $x(x-1)$ are factors of the given expression, it follows that 5, 3, and 2 are divisors of $x^{13}-x$. Hence all numbers of the form $x^{13}-x$ are divisible by 2, 3, 5, 7, and 13, a more complete result than the one given by Mr. Springer. It is clear that this method may be applied to all numbers of the form x^p-x, since x^p-x can always be resolved into factors. Thus, $x^{61}-x$ may be considered a multiple of the following expressions: $x(x^{60}-1)$, $x(x^{12}-1)$, $x(x^{10}-1)$, $x(x^6-1)$, $x(x^4-1)$, $x(x^2-1)$, and $x(x-1)$, and hence numbers of the form $x^{61}-x$ are divisible by 61, 31, 13, 11, 7, 5, 3, and 2.

The third result is also a special case of Fermat's theorem, for according to (1) we have

$$x^{10}-1 \text{ is divisible by } 11,$$

or $(x^5-1)(x^5+1)$ is divisible by 11, i. e., either x^5-1, or x^5+1 is divisible by 11. In general, since p is an odd number (excepting $p=2$), $p-1$ is even, and $\frac{p-1}{2}$ is an integral number. Therefore

$$x^{p-1}-1=\left(x^{\frac{p-1}{2}}-1\right)\left(x^{\frac{p-1}{2}}+1\right).$$

Hence, according to (1) $\left(x^{\frac{p-1}{2}}-1\right)\left(x^{\frac{p-1}{2}}+1\right)$ is divisible by p, and since p is prime, either $x^{\frac{p-1}{2}}-1$, or $x^{\frac{p-1}{2}}+1$ is divisible by p. Thus $x^6\pm1$ is divisible by 13, $x^{14}\pm1$ is divisible by 29, etc.

Finally it may be said that the formulæ for integral values of a, b, and c, satisfying the equation $a^2+b^2=c^2$ are very old, and quite generally known. They can be easily obtained by the general methods of solving indeterminate equations of the second degree.

ARTHUR SCHULTZE.

New York University, November 2[illegible] 1908.

A DEFENSE OF THE WRIGHT SYSTEM OF PROPELLERS.

To the Editor of the SCIENTIFIC AMERICAN:

I have read from time to time criticisms of various details of the Wright machine, particularly as to the use of twin propellers. The unfortunate accident at Fort Myer has in most cases been used as a strong argument against them.

It strikes me that it is about time that someone had something to say in defense of this feature. I was personally a witness of the accident and fully believe that the real immediate cause of the accident was the breaking of the rear rudder and its gear.

To be sure, this was caused by one of the propellers striking a guy-wire, which held the top strut in place; but it is extremely probable that if a single propeller or tandem propellers had been in use the resultant injury to the rear rudder would have been the same if a rear rudder guy had projected in the path of the single propeller. To understand how this injury to the rear rudder caused the accident it is well to consider just how the warping of the planes in conjunction with the rear rudder is used to maintain the transverse stability and also to make turns.

If the rear of the right wing is depressed a certain amount, the rear of the left wing raised a corresponding amount, and the plane forced *straight forward*, then, as the angle of incidence of the right wing is increased and that of the left wing diminished, the right side of the plane will tend to rise. However, when this is done (i. e., the wing warped) the head resistance of both planes is increased a certain amount, and if we consider the planes alone and leave out of the question the forward movement, it will be seen that, under the circumstances, the planes will tend to turn to the right under the resistance of the air and the force of gravity. If we move our rear rudder to steer the planes to the left, then we can overcome the tendency to move to the right caused by the warping of the planes. In this case the right side of the plane will be tilted up, if the plane is moving through still air. Or this movement can be used to counteract a tendency to overturn the planes to the right caused by a strong gust of wind coming from the left. In turning to the left the rudder is used, and the planes are tilted so as to incline the machine to the inside of the curve in a similar manner to that in which a bicyclist inclines his wheel in rounding a curve.

My theory of the accident is as follows: Most of the turns during all the flights of Orville Wright were made to the left. This of course would tend to stretch the left-hand rudder stays. The accident happened just as a turn was being made or about completed. It is probable that Mr. Wright was about straightening up for a straight run. To do this he would need to steer to the right, which would slacken the left rudder guy and cause it to sag in the path of the left propeller with disastrous results, both the propeller and the rudder being put out of commission. For a time the right-hand propeller continued to turn, and this tended to tilt and steer the machine still further to the left.

Naturally, even after the power was turned off, the response to the warping of the planes was sluggish, and the machine lost headway owing to the increased head resistance caused by the warping. The result was to cause it to pitch forward, by reason of the change of the center of pressure caused by the loss of forward motion. Before the longitudinal balance could be regained the machine struck the ground.

An examination of any of the pictures of the machine after the accident will show the broken rear rudder. As all witnesses seem to agree on the fact that the machine struck the ground head on a very cursory examination of the pictures will convince any thinking person that the damage to the rear rudder could not have been caused by the machine striking the ground at that end.

The slight mishap to Wilbur Wright in which one of his chains broke goes to prove that the loss of the propelling effect of one of the propellers is not in itself enough to cause a serious accident, since he easily came to the ground without any damage to the machine or passenger. In fact the turning effect was probably much stronger in his case than in that of Orville Wright, since there was part of the left propeller blade in action which would tend to counteract that of the other.

Twin screws have certain advantages on boats, and these are very much accentuated on aeroplanes. In the first place there is with single screws a tendency to tip the plane sidewise in the opposite direction in which the screw turns, which effect is entirely neutralized with twin screws.

Furthermore a screw shows much more efficiency at low than at high speeds. The practical limit of the diameter of the screws is about the distance between the planes. Hence by using two screws instead of one, the thrust will be doubled simply by doubling the power. The real lesson to be learned from the accident is not that twin propellers must be discarded, but that braces on any type of airship must be so arranged that it is impossible for them to come in contact with the blades of the screws. Santos Dumont learned this very early in his experiments with dirigibles.

One correspondent criticised the use of a chain drive and advocated the use of bevel gears. It is probable that no one realizes more than the Wrights themselves that their machine has many shortcomings in minor details. The fact must be borne in mind that the Wrights were not persons of unlimited means, and naturally they chose the methods which were the least expensive and likely to give the results wanted. It is probable that the chain drive as used by them costs less than a tenth of what even a passably good bevel drive would have cost and gives service that could only be surpassed by a bevel drive of the very best design, workmanship, and material.

The Wright machines of to-day are but copies of a successful experimental machine and as such naturally lack many of the minor refinements which are bound to come when the machine becomes a regular manufactured article. However, even in its present form it would seem to be capable of winning most of the prizes offered for various feats of aviation.

HAROLD S. BROWN.

Boston, Mass., December, 1908.

The Current Supplement.

To many a man who has had to do with electric currents in some form or other, the question has risen, either in his own mind while at work, or in some discussion with a friend: "What does direct current mean? What is the difference between a direct current and an alternating current?" Mr. S. A. Fletcher states the difference very simply and clearly in the opening article of the current SUPPLEMENT, No. 1721. One of the features of the Dayton meeting of the Ohio Society of Mechanical, Electrical, and Steam Engineers was a discussion of the relative merits of the steam and gas engine. That discussion is summarized. Italian naval architects have suggested the use of concrete as an armor for warships. What it costs to break an Atlantic steamship record is set forth. G. H. Bryan gives a very succinct account of aeronautic principles. Dr. Andrew Wilson writes on the human engine, in which he carries out the idea that a good many analogies exist between machines of man's making and his own body. Concrete is admirably adapted for many purposes upon the modern country estate. It may be successfully used by the laborer with fair intelligence under proper supervision. Mr. Lino White in a very exhaustive article gives carefully worked-out details of the manner in which material may be thus used. An interesting article describes two remarkable sense organs, one of which is a thermoscopic eye, and the other a light-projecting eye.

At Bolthead, on the Devonshire coast, a wireless station has just been opened by the postmaster-general of the British post office. This station is intended to establish communication with ships at sea. It is stated that this is the first of a series of similar stations which are to be maintained by the post office throughout Great Britain.

A NOVEL SYSTEM OF CONCRETE CONSTRUCTION.

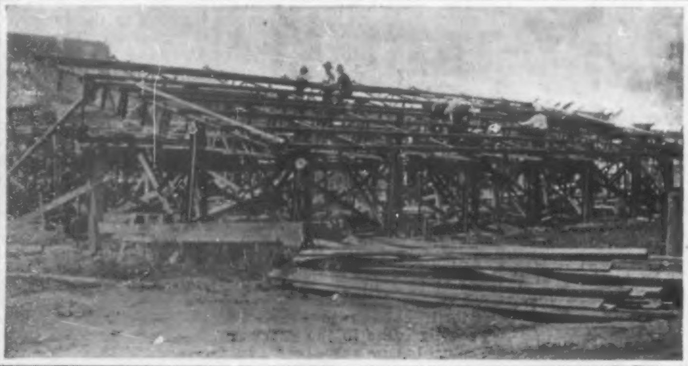
BY DAY ALLEN WILLEY.

A novel method of building construction has recently been carried out in connection with structures being erected for the State militia at Camp Perry, Ohio. The use of concrete in the composition of the walls has permitted them to be practically completed before being placed in position. This is especially true of the mess hall, which is one of the largest structures of the group.

The process of constructing a wall was as follows: First a platform of 2-inch lumber was laid across steel beams about 4 feet apart, these beams being supported by jacks. The platform was about 3 feet from the ground, and lay inside the limits of the proposed building. Four-inch boards were set up on the four sides to complete the form. On the platform were placed the window frames and the reinforced concrete cornice, which was molded in 6-foot sections, 3 feet wide. In this case special ornamental window caps were required, and these were cast separately and placed in their proper positions on the platform. Then concrete made of one part cement, one and a half to two parts sand, and four parts crushed stone, was poured upon the platform. After about 2 inches of concrete had been laid, twisted steel rods for reinforcements were placed in both directions, 6 inches apart, and the balance of the concrete was poured on. The wall was made 4 inches thick. As a facing, a cement mixture of one part white cement to one and a half parts white sand was laid on the surface.

The work was allowed to stand forty-eight hours

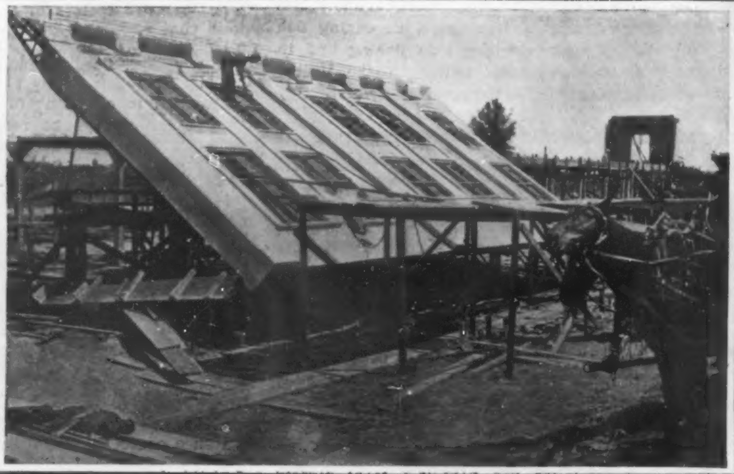
(*Continued on page* 474.)



Setting up the jacks for the wall mold.

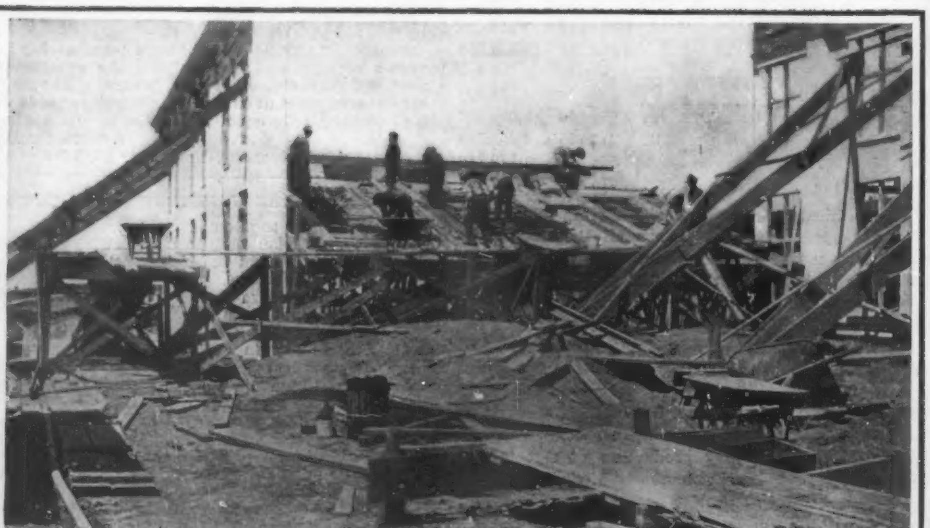
Laying the reinforcement of the walls.

Laying the floor slabs.



Raising a 48-foot section of wall.

Rear view of a wall almost in position.



Two walls in position. Intersecting wall under construction.

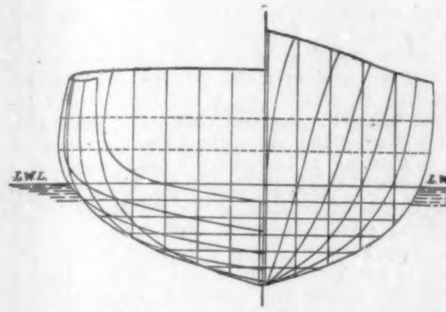
A 76-foot wall coming to position. Vestibule in front already set up.

A NOVEL SYSTEM OF CONCRETE CONSTRUCTION.

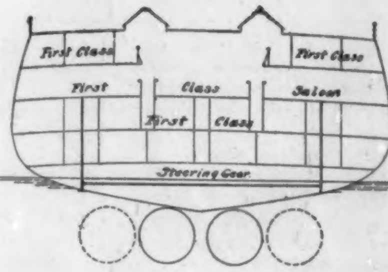
FAST STEAMERS BUILT ON "TETRAHEDRAL" LINES.

BY OTTO KRETSCHMER.

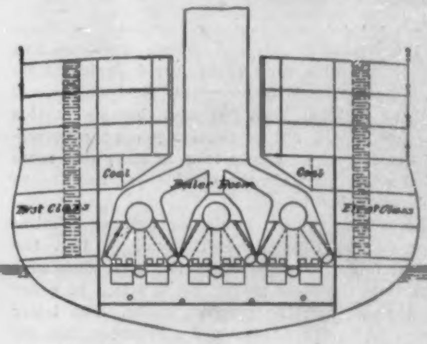
The performance of the steamer "Lusitania" of the Cunard Line has caused the subject of the 25-knot express steamers to become acute again, and the question arises whether, with a lower displacement and correspondingly lower engine power, greater success cannot be obtained. A solution of this question is not merely technically important. Above all, the shipbuilders and the large steamship companies are vitally interested, for economic reasons, in arriving at a solution of the question; for it would enable them to invest less money in this field of transatlantic passenger transportation than is at present required when such a giant boat has to be constructed. If it should become technically possible to construct for the same sum as is now sunk into one of these vessels, two of them, this would signify an economic success which would cause an unprecedented revolution in the domain of international service, by reducing the price of the trips, increasing the number of voyages, and finally shortening the length of the passage.



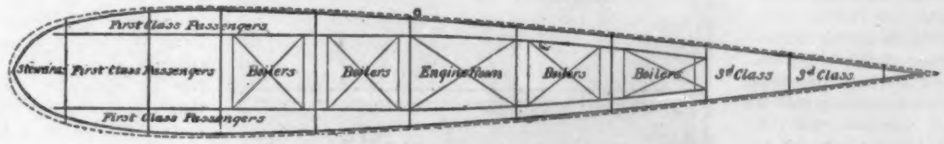
The sections change from a sharp V at the bow to a flat U at the stern.



Cross-section showing passenger accommodations in after portion of vessel.



Cross-section through after boiler room.



Deck plan showing motive power in center and passenger accommodations at side of ship.

What means to employ to bring about this revolution is the first consideration that arises for discussion.

In regard to the engine, a radical change cannot be expected; for in the piston engine probably the greatest possible perfection has been reached. The steam turbine is just entering upon its further development; but even here it may be predicted almost with certainty, that any considerable reduction of the displacement of these vessels cannot result therefrom. Hence the only thing that remains is to try to modify the shape of the submerged part of the vessel, and to ascertain, if only theoretically at first, whether this will lead to the end desired.

Large area of waterline plane, with slight resultant displacement, is adapted in itself to produce great velocity with little engine power. The ordinary construction of the vessel expressed in the "beam," or mathematically in the parallelopipedon or the hexahedron, which is their fundamental form, prohibits taking the means indicated on account of various objections which would preclude their employment. It is the shape of a fish. Hence of an animal which moves in a medium, the water, like the bird in the air, and not at the border of two media, water and air, like the ship.

Such a ship construction will be best adapted to fulfill the requirement mentioned above, viz., large area of waterline plane with sufficient resultant displacement. The best prototype from the animal kingdom for this purpose is the swan, which when swimming dives down the deepest in the front, with sharp entering lines of its front body and full, round, spoonlike lines of its hind body. The geometrical fundamental form for a similarly shaped ship construction is certainly afforded in the tetrahedron.

This construction or model has long been accepted as the best for high-speed motor boats, and it has given high speed with comparatively small displacement. In this branch, viz., that of building small vessels, it has been adopted almost exclusively as the most successful, most convenient, most seaworthy as well as the simplest and easiest-to-handle design or construction. It is interesting to note, in the case of the duck, which may also be considered an animal representative of the tetrahedron, how it dips down in the front and lifts itself up in the back when desiring to swim quicker.

The fast steamer of the Cunard Line, "Lusitania," according to the information at hand, possesses the following dimensions:

Length between perpendiculars.	790	feet
Beam	88	feet
Draft	37½	feet
Displacement	45,000	tons

The engine power is said to amount to 65,000 horsepower, but is probably 72,000 horse-power. The speed obtained on a trial of 1,200 miles was 25.4 knots per hour.

The fundamental form of the submerged hull of the "Lusitania" is the parallelopidedon.

A fast steamer designed on the tetrahedral lines possessing

Length between perpendiculars...	656.0 feet
Beam	78.7 feet
Draft	24.6 feet
Displacement	16,800 tons

showed at the model towing tank tests in the Admiralty Basin at St. Petersburg the following results:

Speed 16.3 knots, actual horse-power, 4,150
Speed 19.6 knots, actual horse-power, 7,450
Speed 22.8 knots, actual horse-power, 13,120
Speed 25.0 knots, actual horse-power, 19,000
Speed, 26.03 knots, actual horse-power, 22,500
Speed, 29.7 knots, actual horse-power, 37,900

For the tertahedral construction we may assume that the proportion of the actual horse-power to the indicated horse-power lies between 0.7 and 0.8, unless the actual horse-power ascertained in the basin should, as is very probable, as with torpedo boats, be equal to the indicated horse-power actually developed later on.

On the basis of these model towing tests two express (high-speed) steamer types have been designed by the author, which have furnished the following dimensions with computation of the weight-groups given below which constitute the displacement.

Project I, for a speed of 26.5 knots but probably 30 knots—

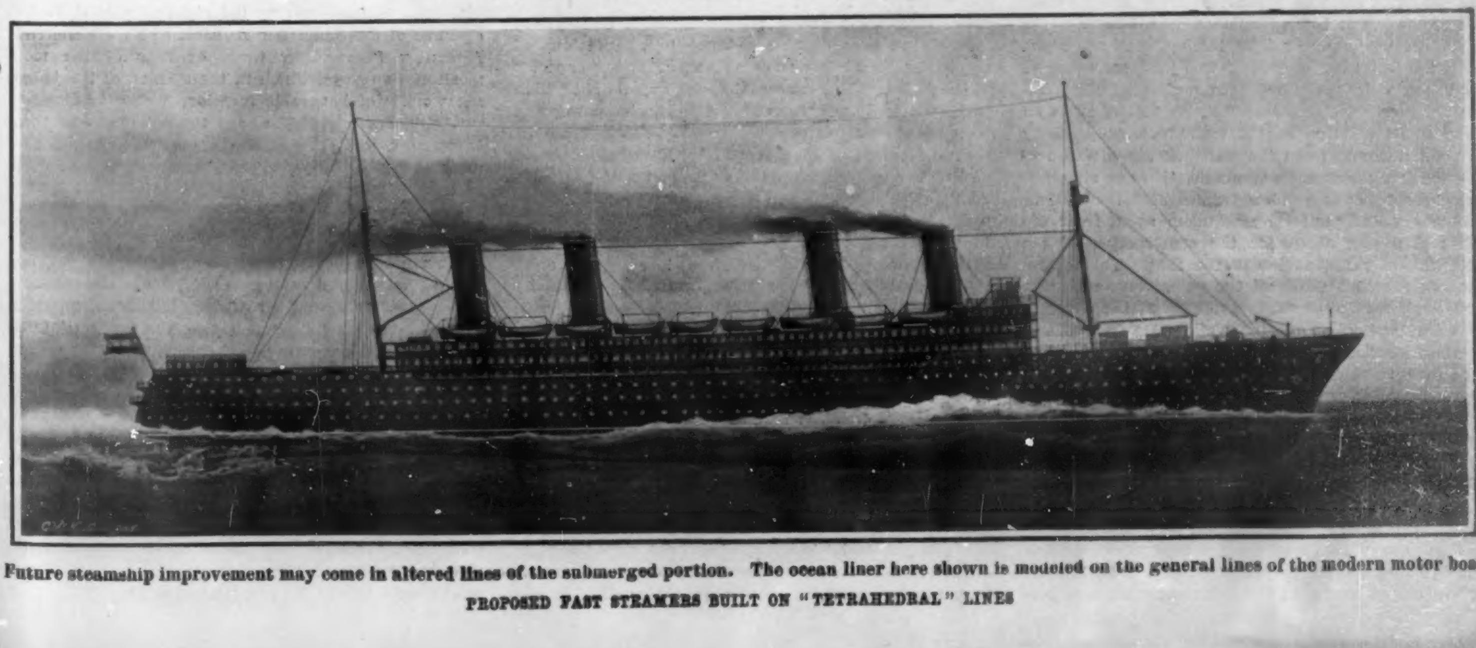
Length between perpendiculars..	754.0 feet
Beam	98.4 feet
Draft with half the coal........	24.6 feet
Displacement with half the coal..	18,700 tons
Horse-power.	40,000

Weights.

Hull, with fixtures..............	11,000 tons
Boiler rooms	1,980 tons
Engine rooms	950 tons
Water for the boilers............	100 tons
Reserve inventory	250 tons
Four propellers..................	16 tons
Shafts, etc......................	204 tons
Coal, one-half	2,500 tons
Equipment	1,000 tons
Passengers, with effects.........	500 tons
Cargo	200 tons
	18,700 tons

Project II, for a speed of 25 knots—

Length between perpendiculars...	656.0 feet
Beam	78.7 feet
Draft with half the fuel..........	24.6 feet
Displacement with half the fuel..	14,400 tons
Horse-power	20,000


Future steamship improvement may come in altered lines of the submerged portion. The ocean liner here shown is modeled on the general lines of the modern motor boat.

PROPOSED FAST STEAMERS BUILT ON "TETRAHEDRAL" LINES

Weights.

Hull, with fixtures	9,600 tons
Boiler rooms	960 tons
Engine rooms	480 tons
Water for the boilers	50 tons
Reserve inventory	150 tons
Four propellers	14 tons
Shafts, etc.	180 tons
Coal, one-half	1,500 tons
Equipment	800 tons
Passengers, with effects	500 tons
Cargo	200 tons

For the operation Richard Schulz turbines and Yarrow boilers with very slight forced draft are intended. In the normal displacement for both projects one-half the fuel has been put down because in this construction it will not be necessary upon consumption of the fuel to gradually take in more and more water ballast to maintain the stability, as has always been necessary heretofore.

Mr. Stuyvesant, of St. Louis, as well as Admiral Fournier of the French navy, also hold that the tetrahedral form for ships offers the least resistance and that it is the most perfect construction in order to obtain great, and the greatest, speed. The latter has presented to the Académie des Sciences, through M. Bertier, chief constructor of the French navy, a paper on "Carène à grandes vitesses" in which he likewise furnishes the theoretical proof for the above views.

A NEW AND INTERESTING MOTOR CYCLE.

BY ARTHUR H. J. KEANE, M.J.I.

The "Max" motor cycle (Claude Johnson's patent) is a light and comfortable machine of the "runabout" type, intended for short-distance work at moderate speed, absolute safety for the rider being assured. In the ordinary pattern no seat is provided, the rider adopting a standing position on footplates which are within a few inches of the ground. In this position the rider has perfect control over the machine. There is none of that feeling of fatigue and ennui generally experienced after a run on the ordinary type of motor cycle. This cycle will easily maintain a speed of fifteen miles an hour (maximum). It will climb a hill of 1 in 6 grade at a velocity of ten miles per hour. It is inexpensive both in the consumption of fuel and in maintenance. It occupies very little space, and the footplates fold up to form a stand for the machine when at rest. As the total weight is small, and the center of gravity low, it can be handled with minimum effort, and all tendency to side-slip is avoided.

The latest model of the machine is fitted with a special 1¾-horse-power engine with a back gear, so that a large belt pulley may be used, and Sims magneto ignition. The frame is arranged with a continuous curved tube to carry the engine, these being intended to replace the holding lugs used in the former models. The wheels are 18 inches in diameter, and are fitted with 18 x 2-inch tires of the type mentioned above. The fuel tank has a capacity of about 1⅛ gallons, or approximately enough for a 100-mile run. The control is effected almost entirely by means of a throttle and thumb switch, exhaust valve, lifter, front rim brake and drum brake on the engine—all controlled from the handle-bar. The weight of the machine complete is only 85 pounds. The wheel base is 39 inches, the length over all 58 inches, the total height 38 inches, while the handle bars are 18 inches wide.

A NOVEL SYSTEM OF CONCRETE CONSTRUCTION.

(*Concluded from page 472.*)

to give the material time to solidify, when preparations for lifting the wall to its permanent position were made. This was a comparatively simple task, most of the power being furnished by a 5-horse-power engine. It was connected by belting with the shaft under the platform operating the jack screws, and slowly the wall was tilted into position. The platform supports were so placed that the foot of the wall swung to its position on the foundation at precisely the right line and when the wall had assumed a vertical position, every line was plumb. Five or six wood props braced to the window frames held the wall in position and the platform was taken away from the back and swung about for the construction of the next wall, at right angles to the first. This operation was repeated until all the walls were up. The reinforcing rods were set to protrude at the edges of the walls, and when all the walls were in position, the rods interlocked at the corners of the structure. They were twisted together, and an 8-inch board, the only false work used in the construction, was placed inside the corner. Here concrete was poured in, a joint made on the outside corner and the two walls thus bound together.

As the photographs show, the mess hall is two stories in height and presents the appearance of massive construction, yet each wall was molded and set in place in less than three days' actual working time, although they have a height of 26 feet. The interior construction was also of the same material, and here again a plan original with the engineer in charge, Mr. R. H. Aiken, was followed. Columns 8 inches square and 10 feet 8 inches long were used in connection with girders 15 feet in length and 8 by 12 inches in thickness. Their reinforcement consisted of 16 ¼-inch steel rods to each member. Upon these girders were placed the floor slabs 3 feet wide and 2½ inches thick. Those of the first floor are reinforced with ¼-inch twisted bars, both ways, 6 inches apart; the second floor slabs have similar reinforcement, 4 inches apart. The slabs were molded in the following manner: On a bed of sand four cylinders were set, having holes to receive the steel rods that protruded about 6 inches on all sides of the finished slab. The concrete was poured in very wet, and tamped but little. Ten minutes after the first slab was molded, a sheet of heavy paper was spread on it, a new form placed on top and a second slab rested over the first. When the slabs were completed they were left to solidify and did not have to be handled again until placed in the floor.

In the floor, the reinforcing bars of the slabs interweave at all sides. A board was placed under each joint and concrete poured in, forming a perfecting bond. In this, as in all similar cases on this work, the hard concrete was thoroughly wet before the cement mortar for the joint was applied. With the joint, each slab is 42 inches wide. After the slabs were laid, they were moistened and a top coat of concrete spread over the entire floor, bringing the thickness up to 6 inches. This has been termed the unit system of construction, but another method adopted was to mold the supports on the ground, then set them in place according to the plan sometimes followed in setting steel columns. By the method described no delay ensued in construction and no party of workmen was obliged to wait upon others engaged on the building.

THE "MAX" MOTOR CYCLE.

How far this system can be employed in building construction is an interesting question. Apparently it could be utilized in wall formations of much larger dimensions than those described, provided the adjustable framework for supporting the wall is of sufficient strength to give equal resistance to all portions of the load while being raised. As the lifting capacity of the jack can be increased to meet any weight which may be placed upon it and the mechanical power can be suited to all the requirements it would seem as if concrete buildings of much larger dimensions could be literally molded upon the ground even to the ornaments of the exterior and much of the interior framework, for if a wall is too large to be cast, so to speak, in one section it can be formed in parts and then raised upon its permanent site.

Where this plan of erection can be successfully accomplished without affecting the strength of wall or putting undue stress on the work it possesses many advantages that are apparent—not merely in time saving but in labor saving, also in curtailing the space usually required in building operations so valuable in large cities. In the erection of a frame, brick or stone structure much of the time required is to "lay up" the walls piece by piece. All of the material must be elevated and transferred to the workmen. This represents far more time than that employed in the actual labor on the undertaking, while expense of conveying material is a large item of the contract. It is also evident that a wall or other portion of a structure can be completed more thoroughly when on the ground than from the aerial scaffold, since it is more accessible and far more men can work upon it to advantage, while each can accomplish more than he can by the ordinary process.

The practicability of "molding" a building on the ground, then raising and assembling the completed structure, is admitted by United States engineers who have examined the work at Camp Perry with the view of employing the method in military service and have given it their official approval. Col. O. B. Parsons, State engineer of Ohio, gives his opinion as follows:

"As regards the construction, I would say that I am convinced that it is both practical and economical inasmuch as it does away with an untold waste of lumber and admits of a much stronger wall being built with less material. Practically all the lumber that is used is the planks on which the walls are molded, and they are used over and over without being cut or nailed. In constructing a wall in this way the mixture does not separate as while being poured from the top of a building and there is also a great advantage in finishing, as one man will finish more than a half dozen will on a scaffold, do better work, and there is no trouble in bonding, as the surface is put on before the other material is dry."

At Camp Perry this plan of erection is being employed in another interesting way. A wall for supporting rifle targets was included in the plans. It is also formed of concrete but all of it is composed on the ground in sections, no less than 130 feet in length. These are, of course, molded upon framework located at the site of the wall, which is ten feet high and six inches thick. Consequently when a part of the barrier is set in place it is necessary to lift all this mass of concrete at one time, but the system of jacks supporting the adjustable framework has been efficient for the purpose, showing that the Aiken method is adapted to construction on a large scale.

A $500 Prize for a Simple Explanation of the Fourth Dimension.

A friend of the Scientific American, who desires to remain unknown, has paid into the hands of the publishers the sum of $500, which is to be awarded as a prize for the best popular explanation of the Fourth Dimension, the object being to set forth in an essay the meaning of the term so that the ordinary lay reader can understand it.

Competitors for the prize must comply with the following conditions:

1. No essay must be longer than 2,500 words.
2. The essays must be written as simply, lucidly, and non-technically as possible.
3. Each essay must be typewritten and identified with a pseudonym. The essay must be inclosed in a plain sealed envelope, bearing only the pseudonym. With the essay should be sent a second plain sealed envelope, also labeled with the pseudonym, and containing the name and address of the competitor. Both these envelopes should be sent to "Fourth Dimension Editor, Scientific American, 361 Broadway, New York, N. Y."
4. All essays must be in the office of the Scientific American by April 1, 1909.
5. The Editor of the Scientific American will retain the small sealed envelope containing the address of the competitor and forward the essays to a Board of Judges, who will select the prize-winning essay.
6. As soon as the Board of Judges have agreed upon the winning essay, they will notify the Editor, who will open the envelope bearing the proper pseudonym and containing the competitor's true name. The competitor will be notified by the Editor that he has won the prize, and his essay will be published in the Scientific American.
7. The Editor reserves the right to publish in the columns of the Scientific American or the Scientific American Supplement three or four of the more meritorious essays, which in the opinion of the judges are worthy of honorable mention.

The judges who will award the prize will be three in number, and all will be eminent American mathematicians. The names of the judges will be announced in a later issue of this journal.

To Our Subscribers.

We are at the close of another year—the sixty-third of the Scientific American's life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year. To those who are not familiar with the Supplement, a word may not be out of place. The Supplement contains articles too long for insertion in the Scientific American, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the Scientific American and Supplement the subscriber receives the benefit of a reduction in the subscription price.

A NEW INCANDESCENT GAS MANTLE.

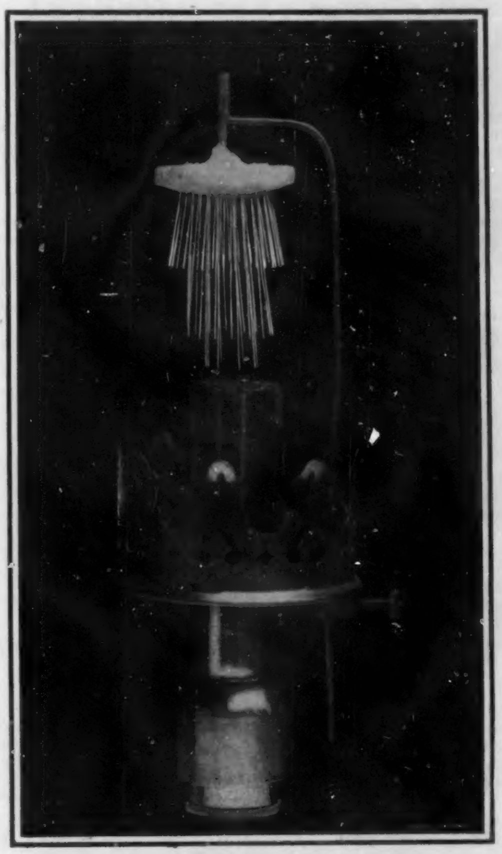
Numerous efforts have been made from time to time to effect improvements in the incandescent gas mantle invented by Dr. Auer, with a view to securing additional strength and attendant prolonged durability, but the fragile and perishable character of the cotton foundation rendered such attempts only moderately successful. The majority of such improvements proved only to be of a temporary nature, with the result that the mantle soon lost its power of incandescence.

Greater success, however, has attended the experiments of a recent inventor. In this device the cotton foundation is abandoned, and instead a cage or "bush" of thin rigid filaments projecting from a solid base, on much the same principle as the bristles of a brush, is used. The principle of the invention is based upon obtaining by fusion at a very high temperature radiant and unchangeable threads composed of various oxides. These filaments are perfectly solid and white, closely resembling glass or porcelain. They are made in the form of rods or needles of a thickness of 0.8 millimeter (0.03 inch) and from 25 to 30 millimeters (0.98 to 1.18 inch) in length. As may be seen from the accompanying illustration, the rods or needles are disposed in three rows of different lengths in the form of a bush, and the intensity of the incandescent illumination obtained is controlled by the number and length of these bristle-like filaments.

The threads are raised to a high state of incandescence by the blue flame of the Bunsen burner in precisely the same manner as the ordinary Auer mantle, the flame being projected into the center of the overhanging bush by means of a special gas injector in the burner. Any shade or tint of light preferred can be secured merely by the introduction of certain oxides in the production of the filaments. Moreover, owing to the great strength of the threads, the light can be made in a variety of forms—flat, inverted, round, or assume fanciful designs, such as flowers, stars, and so forth—rendering it useful for decorative purposes. Furthermore, it can be adapted to any system of gas illumination with equal readiness and success, such as petroleum, natural gas, gasoline, alcohol, etc., and can be used with portable lamps.

The filaments are of great strength considering their spider-thread-like thickness. In fact, if a rod be placed between the thumb and finger, it cannot readily be broken. Changes of temperature exercise no harmful effects, nor is it affected by drafts, wind, or rain. A mantle can be taken from the burner while in a perfect state of incandescence, plunged into cold water, and then reinstated over the flame without sustaining injury or any impairment of its efficiency.

The mantle is suspended in position over the flame by the hook of a thin fork, which slips into the slot of the metal holder of the mantle, and all that is necessary to do is to see that the bush is centrally placed over the burner, and that the strongest filaments are not more than ¼ inch distant from the burner, adjustment in this direction being secured by sliding the supporting rod up and down in a small clutch at the side clamped by a screw. Control of gas is effected by means of a small screw regulator at base of burner, by means of which it is possible to enable just sufficient gas to be passed to the burner to raise the filaments to their maximum state of incandescence, and without any waste of gas. One of these mantles under normal conditions of working will last from two to three years, and there is no accompanying diminution in the intensity of the light emitted with use.



A "BUSH" OF FILAMENTS AS A SUBSTITUTE FOR THE GAS MANTLE.

THE MEASLES CANNIBAL.

BY CRITTENDEN MARRIOTT.

A few years ago, an epidemic of measles broke out among the Indian tribes living on Vancouver Island in British Columbia, not far from Fort Rupert, and the shamans or medicine men came to the conclusion that a cannibal sorcerer, whom they termed the *hamatsu* (measles cannibal), was slaying their children to eat them, and that he would continue to do so until he was killed.

As they could not slay a ghost in his own person, they arranged a ceremony in which one of their number posed as the cannibal, and was treated as they would have liked to treat the real foe. This fact of a substitute was, of course, not made public, only the medicine men knowing the truth of the matter.

Against a wall of rock was painted an imitation opening, in the center of which the "cannibal" was fastened, just as he appears in the accompanying photograph (which, by the way, was not taken at the time, but some days later, when the medicine men were induced to give a private exhibition for the benefit of members of the Bureau of Ethnology). At the proper time, after going through various incantations, a covering was jerked away, exposing the cannibal, apparently springing through the solid rock. He was promptly grasped by two of the priests, who dragged him out and rushed him through a fire which was burning in front of the place and which was surrounded by all the members of the tribe, beating drums and singing at the top of their voices. By some jugglery, the cannibal was gotten rid of, and the people were told that he had flown away through the air and would not come back.

After this ceremony had been repeated several times to put an end to other epidemics, which were only too prevalent among the Indians, it grew into a sort of annual affair, managed by the members of a secret society whose members know that the supposed *hamatsu* was only a man.

THE MEASLES CANNIBAL.

Ammonio-Copper Processes of Making Artificial Silk.

The production of artificial silk steadily increases as the strength of the product is increased. Silk made from ammonio-copper solutions of cellulose is cheaper than silk made from solutions of nitrocellulose, and its manufacture appears to be on the eve of a great development. A great many processes have been devised, as is indicated by the following list:

Early Processes.—Despleasis Process.—This is the earliest process and the foundation of the others. It consists in dissolving cellulose in Schweitzer's reagent (ammoniacal solution of hydrated oxide of copper) and forcing the viscous solution through spinnerets into a weak acid bath which coagulates the mass and consequently transforms the liquid streams into solid fibers, from which the ammonia and the copper are removed, and recovered, by washing. The French patent was issued in 1890 and expired at the inventor's death in 1892.

Pauly Process (1897).—The solution is formed without heating, by an immersion lasting a week, in order to increase the strength of the fibers.

Fremery and Urban Process.—The cellulose is first oxidized, in order to lessen the time required to dissolve it, and the fibers receive special treatment to increase their strength and gloss. These processes are employed in the factory at Oberbruch, Germany.

Mulhouse Process.—Cotton bleached, mercerized, again bleached and ground with copper sulphate. The mixture is dissolved in strong ammonia.

Soie Parisienne.—The cotton is ground with sulphate or carbonate of copper and dissolved in a 14 per cent solution of ammonia at 32 deg. F. The fibers are coagulated in strong sulphuric acid (up to 80 per cent).

New Processes.—In most of the new processes the cotton is first mercerized. Bemberg, however, converts unmercerized cotton into hydrocupro cellulose by mixing it with sulphate and chloride of copper, caustic alkali and water. The product is then treated with ammonia and exposed to the action of the air. Raw silk or silk wastes may be added to the cellulose. The fibers are spun in a bath containing castor oil and caustic soda.

Foltzer increases the solubility of the cellulose by heating it with alkaline solutions, under gentle pressure.

Linkmayer immerses the cotton in a weak bath, in which it swells, and then in a stronger bath, where it dissolves, and subsequently extracts part of the ammonia of the bath with an air pump, which permits a weaker coagulating bath to be used.

The Hanan Kunstseide Fabrik accelerates solution by saturating the cotton with ammonia and mixing it with a paste of hydrated oxide of copper.

Crumière adds an excess of metallic copper to Schweitzer's reagent.

Draeper dissolves cellulose or hydro-cellulose in an ammoniacal solution of copper carbonate.

Friedrich proposes to substitute alkylamines for the ammonia.

Lecoeur recommends coagulation by bisulphites of the alkalies.

The Soie Nouvelle company obtains very flexible fibers by coagulating and washing in presence of glycerine. Boncquey adds sugar or molasses to the bath and the Société Française des Soies Artificielles uses a coagulating bath of strong caustic soda, mixed with glucose or glycerine.

Guadini employs a mixture of sulphuric and hydrochloric acids.

Thiele passes the fibers through a bath of ether, benzene, chloroform or tetrachloride or carbon, containing oil or grease in solution, which produces partial coagulation, and then through the regular coagulating bath.

Linkmeyer and Kracht also effect the coagulation in two stages, with a weak and a strong bath, in order to prevent the fibers adhering to each other.

Finally, in several processes the semi-liquid cellulose is treated with caustic alkali, or the coagulated fibers are mercerized with caustic soda, chloride of zinc, or acids. Linkmeyer and Pollak subject the fibers to tension during mercerization.

Experiments are being carried out in the German navy with acetylene shells, which have been designed to take the place of searchlights. The shell is fired from a special gun, so as to fall in the water in the neighborhood of a hostile ship or fortification. It is ignited on striking the water, and each shell has been constructed to burn with 3,000 candle-power for a period of three hours.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

ABDOMINAL REDUCING-CORSET. — S. Bernstein, New York, N. Y. The more particular purpose of the invention is to provide a type of corset having portions, the general diameter of which can be contracted by degrees, and also having an auxiliary flap adapted to occupy different positions representing different diameters for the corset and provided with appropriate means located with reference to the position of this auxiliary flap.

Electrical Devices.

INSULATOR.—C. Rosenberg and V. T. Bailey, New York, N. Y. In the present patent the invention is an improvement in insulators such as used in connection with incandescent electric lamps, and has for its purpose to relieve the binding screws or posts of the strain incident to the stringing and the stretching of the wires.

TERMINAL FOR ELECTRIC WIRES.—B. Morgan, Newport, R. I. The object of the invention is to provide a form of tip, whereby the liability of the tip becoming detached from the conductor is reduced to a minimum, in which extensive contact is made between the conductor and the tip, and in which the latter may be readily secured to or detached from a binding post or the like, without the aid of any wrench, clamp, or other tool.

REGULATION OF THE PERIOD OR INDUCTANCE OF HIGH-FREQUENCY CIRCUITS.—G. Ferrié, 51 bis Boulevard de Latour Maubourg, Paris, France. The invention consists in providing in proximity to the inductance windings other conductors, preferably surrounding said windings and in short-circuiting a portion of such other conductors, the inductance being regulated by varying the relative position of the inductance windings and surrounding conductors and the position of the short circuit.

Of Interest to Farmers.

VENTILATOR FOR HEN-HOUSES OR BROODERS.—G. H. Lee, Omaha, Neb. While the ventilator is intended to be used particularly in connection with brooders and hen houses, it is capable of general use as a ventilating device, that is, where an inner compartment or chamber is to have its air refreshed through communication with the outer air.

WAGON-BODY AND HAY-RACK LIFTER.—W. C. Wilson, Livermore, Iowa. The invention consists in an improved construction of wagon body lifter, in which special provision is made for bringing down the body in proper relation to the running gear when it is to be reconnected, thus avoiding all heavy lifting and making the reconnection of the wagon body to the running gear automatic as well as its disconnection from the running gear.

BEEHIVE-CARRIER.—A. C. Brovald, Finley, Wis. In this patent the wheel barrow is equipped with novel grasping and holding devices for the hive. The centers are so arranged that when the barrow is brought to an approximately upright position adjacent to the hive, certain members on which the hive rests are centered beneath the same; whereupon the arms for grasping the hive and which are manipulated from a point near the handles are brought into proper position to securely engage the hive and properly supported in the barrow when transported.

Of General Interest.

SAFETY-RAZOR.—T. F. Curley, New York, N. Y. The object of this inventor is to provide a razor arranged to permit of conveniently placing the blade into accurate position on the frame or holder relative to the guard thereof, and to provide a back plate for giving the desired rigidity to the blade and which back plate can be readily opened or closed and securely locked in place when in a closed position.

HOSE-NOZZLE.—F. J. Radler, Jersey City, N. J. The connections of this nozzle are particularly adapted for use with hose on fire water-towers, stand-pipes and the like, the object being to provide a nozzle with connections whereby it may be readily turned in various directions, the connections being so constructed that no leakage can occur at the joint.

PROCESS FOR THE MANUFACTURE OF RESINOUS PRODUCTS CAPABLE OF REPLACING NATURAL RESINS.—L. Grognot, 18 Rue Labat, Paris, France. Phenols have the property of combining with the aldehydes under the influence of catalytic agents (such as mineral or organic acids, alkaline or other bases) for forming the various resins analogous to the natural resins in their properties. Nevertheless the action of these catalytic agents is difficult to control and beyond what is required. The present process avoids this defect.

MOLDING-FASTENING.—A. C. Goddard, New York, N. Y. Metal doors, windows, and other similar structures are comprised in this invention, and the object is to provide a fastening for securely fastening molding and like parts in place without the use of screws, rivets or similar fastening devices, and without showing the fastening means on the outside of the molding or marring the exterior face thereof.

SHAVING-SOAP CAKE.—L. C. Benitz, Philadelphia, Pa. A conical cavity is worn down by the brush in the center of the top of a soap cake, and the shaving brush finally comes in contact with the bottom of the cup in which the cake is held, and at last there remains nothing of the cake save a thin ring which soon breaks up into pieces or sections that are thrown away and thus wasted. The invention provides a cake of improved shape that will wear so as to avoid the loss incident to the use of the old form.

WATER-STORAGE SYSTEM FOR USE IN EXTINGUISHING FIRES.—L. H. Sondheim, New York, N. Y. The object here is to provide a system whereby water may be stored in such manner as to be available in the event the usual water supply should fail, as for instance, by the breakage of the water mains by earthquake shock, or such a temporary reduction of the normal pressure occurs in the mains at a given point as to cause an inadequacy in the supply.

WOVEN FABRIC.—H. Sarafian, Yonkers, N. Y. The aim of the invention is to provide a woven fabric, which is soft in tread, and provided with an exceedingly strong yet flexible back, thus rendering the fabric very serviceable for use as a carpet, rug or the like. It relates to fabrics such as shown and described in Letters Patent formerly granted to Mr. Sarafian.

Hardware.

COMBINATION-TOOL.—W. Wrightsman, Evansville, Ind. This tool embodies a center punch, a try-square and a linear scale. An object of the invention is to produce a device having a center punch, and arranged so that when it engages a body of circular cross-section in a suitable manner, the center punch can be positioned at the cross-sectional center of the body.

Heating and Lighting.

BOILER-FURNACE.—J. O'Neill, New York, N. Y. The intention in this instance is to provide a furnace, more especially designed for water-heating systems, and arranged to utilize the heat from the burning fuel to the fullest advantage, to render the furnace exceedingly strong, and durable by constructing the same mainly of sheet metal and brick-work and to allow convenient cleaning of the furnace of soot whenever desired.

Household Utilities.

STRAW-BURNING STOVE.—H. C. Ruggles, Moro, Ore. The invention relates to stoves for use in burning a highly combustible substance as hay or straw. The aim is to produce a stove which is simple in construction and provided with improved means for insuring a good draft and for controlling the draft.

WASHBOARD.—Louise H. Percy, Philadelphia, Pa. The invention has in view the provision of means for supporting the board over the tub in a substantially horizontal and slightly depressed position. Its use prevents backache from bending, prevents injury to the hands, such as callous knuckles and injuries resulting from pins, broken buttons, etc. The finest or coarsest article may be cleaned in one-half the time and in a manner saving long boiling and the use of chemicals.

PORTABLE REEL GAS-OVEN.—G. B. Meek, New York, N. Y. The object here is to prevent heating of the exterior wall by the heat of the gas burners employed in the baking. This is accomplished by forming each of the walls or wall sections with an inner packing of asbestos or other suitable non-heat-conducting material, and outside of the asbestos lining, there is provided a plurality of air passages, so arranged that an automatic circulation of air is maintained.

Machines and Mechanical Devices.

WATER-MOTOR.—H. Brown, Brandt, Ohio. The purpose in this invention is to simplify the piston construction by making the cylinder from the wall of the chambers between the piston faces, to mount the inlet and exhaust ports in the cylinder wall and to provide mechanism intermediate the piston faces for operating the valves.

SAWMILL.—F. O. Willey, Newport, Ind. The object of the inventor primarily is to provide in connection with a saw mill or other like cutting machine a variable feed, which is under the absolute control of the operator, and which will give every possible rate of travel to the feed carriage within certain limits in either direction.

AUTOMATIC STOP FOR TALKING-MACHINES.—R. B. Smith, New York, N. Y. The more particular purpose in this case is to enable a moving member carried by the machine and having a travel related to the progress made by the record to play, to act upon and operate one or more brakes for the purpose of stopping the machine promptly when the playing of the record is completed.

DRIVEN WHEEL.—J. T. Moore and W. J. Fleming, Evansville, Ind. The object of the improvement is to provide a driven wheel wherein the momentum of the driving wheel at all times, when in action, predominates over the driven wheel, and the wheel is especially adapted for use as the driven wheel of a band saw or band knife machine but may be used in any loose pulley where a minimum momentum is desired.

CAMERA ATTACHMENT.—E. L. Hall, New York, N. Y. There is provided in this invention a construction of a camera finder furnished with an adjustable hood that is applicable to any type of camera and which can be expeditiously and conveniently fitted thereto, and which is also capable of being readily removed.

PANTOGRAPHIC SHIFTER.—H. L. Falco, New York, N. Y. The invention relates to printing and arts allied thereto, the more particular object being to provide means for readily shifting a printing film or the like, for the purpose of multiplying the design carried by the film. The mechanism is a system of levers for use in moving the printing film frame and mechanism for guiding the operator as he actuates the system of levers by hand.

Railways and Their Accessories.

RAILWAY-SIGNAL.—M. M. Kane, Montgomery, Ala. This signal is for use in preventing collisions or accidents caused by open switches. The object of the inventor is to construct a signal or semaphore in such a way that it may be readily operated so as to display different colors indicating whether the track is clear or not.

TRACK-SANDER.—J. Schmitz, San Francisco, Cal. The aim of the invention is to provide a simple and efficient track sander, which can be applied to railway rolling stock of various kinds, which is inexpensive to manufacture, and by means of which sand can be distributed in a plurality of directions and delivered to the track at a plurality of points.

TICKET OR RECEIPT CUTTER.—G. McN. Rose, Jr., Nashville, Tenn. The invention is an improved device for use in cutting and thus dividing receipts, or tickets, given for cash fares paid by passengers on railway trains. It is embodied chiefly in the form, arrangement and adaptation for adjustment of the several coacting cutters. The device may be quickly and easily adjusted.

Designs.

DESIGN FOR A GLOVE.—I. Oliver, New York, N. Y. The glove is formed with a hand and a gauntlet portion. The latter is split from the junction of the hand portion therewith to its free end, on the side adjacent to the little finger and the sides of the split are snap fastened. The wrist portion is split from the beginning of the palm upwardly and the sides of the split are provided with buttons and button holes.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Full hints to correspondents were printed at the head of this column in the issue of November 14 or will be sent by mail on request.

Attention has been called by several correspondents to the answer to Query 11007, regarding the properties of aluminium. The editor must say that the latter part of the answer is not entirely justified by the facts in the case. The compounds of aluminium are not to be regarded as poisons and are simply adulterants of food. For this reason some have condemned the use of aluminium dishes, but they are no worse in this respect than tin, if as bad, and excepting the caustic alkalis, the amount of action of these chemicals of foods upon the aluminium is so small that the salts formed cannot be sufficient to do harm.

(11033) B. T. asks how to make buff wheels. A. Turn up the wooden disk to form the wheel on the mandrel on which it is to run. Cover the periphery of the wheel with good glue, prepared as for gluing wood, stretch the leather around and confine it with shoe pegs driven in about 2 inches apart. When dry turn off true with a sharp chisel. Give the leather a coat of glue and roll it in emery, so as to make it retain it by being imbedded in the glue. Let the wheel dry until the glue is hard and it is ready for use.

(11034) C. L. F. asks how to preserve bird-skins. A. Make an incision from the breastbone to the vent; with a small piece of wood work the skin from the flesh. When the leg is reached, cut through the knee joint and clear the shank as far as possible, then wind a bit of cotton wool on which some arsenical soap has been put round the bone; do the same with the other leg. Now divide spine from root of tail, taking care not to cut too near the tail feathers, or they will come out. Next skin the wings as far as possible and cut off. The skin will now be entirely clear of the body. The skin must now be turned inside out and the neck and skin gently pulled in opposite directions till the eyeballs are fully exposed. The whole of the back of the head may be cut off and the eyes and brain taken out and their places filled with cotton wool. The whole skin should be rubbed well with arsenical soap or plain arsenic, and the neck returned to its natural position, when, after filling the body with a little dry grass or wool, the job is done. It is very easy, and the skin of a bird is much tougher than one would suppose, though, of course, they vary, the night-jar being very thin, while humming birds are fairly tough. All the apparatus required is a sharp knife and a pair of scissors, or, for large birds, a strong pair of nippers to divide the bones.

(11035) C. L. asks how to lace belts. A. The ends of a belt should always be cut off square, not guessed at by the eye, but laid off with a tool. The holes ought to be made with a small punch at a proper distance from the end; the size of the holes and the distances of them depending on the width of the belt. The use of an awl is reprehensible, for the holes are apt to be made irregular by it, and much larger than there is need of. The end of the lace should be tied with a square knot in the middle of the outside, for the corners of the belt where it is cut are most exposed and apt to whip out. Tying a belt lace does not look so neat as where the ends are put through an incision, but tying saves the belt from having extra holes made in it. The laces ought to be of the same thickness from end to end, or as nearly so as possible. It often happens that laces have very thin spots in them; such should be kept for short belts, and never used for long ones. Moreover, the holes must be made at equal distances apart and not too many of them. Every hole weakens the belt, and none that are not absolutely essential should be cut. All new laces, as well as new belts, should be stretched by hanging weights on them before they are used; petroleum, sawdust, resin, and similar substances should never be used. When a belt gets harsh or dry, neat's-foot oil is the best thing to apply to it.

(11036) C. M. S. asks: 1. Why does not an arc lamp short-circuit a current or cause a live wire, the same as when the two wires leading from the generator are touched together and pulled apart, thus making an arc? A. The carbons of an arc lamp do not short-circuit the current because the resistance of the coils in the lamp cut the current down to the number of amperes needed to light the lamp. 2. Is there any form of a rheostat used in the ordinary arc lamp? A. There is a rheostat in all arc lamps. 3. Please send me one of the Scientific American Supplements showing the construction of an electric furnace. A. Our Supplement 1182 contains a good article upon the construction of an electric furnace.

(11037) K. G. C. asks: Owing to the precession of the equinoxes, is the apparent diurnal motion of Polaris around the pole of the northern celestial sphere describing now a larger or a smaller circle than formerly, or in other words, is the star approaching or receding from the actual pole? A. At present the distance of Polaris from the North Pole is about one and a quarter degrees. At the time of the Star Catalogue of Hipparchus, it was 12 degrees distant from the pole. It will approach the pole for the next hundred years, at which time it will be within a half degree of the pole. After that time it will recede from the pole, or rather the pole will recede from the star.

(11038) L. C. S. writes: 1. As I understand it the resistance is what makes the field coil get hot. In order to avoid the heating more wire is added; now, if resistance is what heats the coil, how do you account for the coolness of the fields after adding more wire, consequently more resistance? A. Your statement that resistance causes the heating of an electric circuit is less than half right. The exact statement is that the heat developed in a circuit is directly proportional (1) to its resistance in ohms, (2) to the square of the current in amperes, (3) to the time that the current flows in seconds. Now one ampere flowing through one ohm develops 0.24 calorie in one second. Putting these facts in a formula we have: Heat in calories $= 0.24\ C^2Rt$. It can now be seen why the heating of a coil can be remedied by adding more wire. The increase of resistance cuts down the amperes in the same ratio as the increase. But the reduction of the amperes affects the heating power in the ratio of the squares of the amperes. Thus, if the resistance were doubled the amperes would be halved, but the heat produced would be reduced to one-fourth of what it was, since the square of ½ is ¼. 2. What is the cause of the humming in the field coils and pole pieces of an induction motor when the armature does not revolve, but the current is passing through the fields? A. The alternations of an electric current produce vibrations which are heard as sound. These can be heard near an arc light run by an alternating current, or near an alternating electro-magnet. 3. What changes are necessary to reverse the running of an induction motor? Crossing the positive and negative wires at the binding posts will not do it. Of course, merely reversing the main wires will produce no effect upon the direction of rotation of a motor. If the induction motor is two phase, the direction of rotation will be reversed by changing the two leads of either phase. If it is three phase, it will be reversed by changing any two of the leads. The different phases are a fraction of a period behind each other, and the direction of rotation depends upon the direction in which the phases lag behind around the rotating part of the motor, whether clock-wise or contra-clockwise. To reverse the motor the direction of the lag in phase must be reversed. 4. Would it be possible to illustrate and explain the induction motor in the Scientific American some time in the future? A. The induction

motor has been fully treated in several books recently published: Oudin's "Polyphase Apparatus," price $3 by mail; Thompson's "Polyphase Currents," price $5 by mail. These, with Thompson's "Elementary Lessons," price $1.40, will put you in possession of quite a complete library of the subject at present.

(11039) R. W. asks for a rough method of estimating the horse-power of a steam engine. A. Multiply the square of the diameter of the cylinder in inches by 0.7854, and this product by the mean engine pressure, and the last product by the piston travel in feet per minute. Divide the last product by 33,000 for the indicated horse-power. In the absence of logarithmic formulæ or expansion table, multiply the boiler pressure for ⅝ cut-off by 0.91, for ½ cut-off by 0.85, ⅜ cut-off by 0.75, 3-10 cut-off by 0.68. This will give the mean engine pressure per square inch near enough for ordinary practice, for steam pressures between 60 and 100 pounds, always remembering that the piston travel is twice the stroke multiplied by the number of revolutions per minute.

(11040) H. B. asks for a formula for insulating material. A. Linseed oil, 2 parts; cotton seed oil, 1 part; heavy petroleum, 2 parts; light coal tar, 2 parts; Venice turpentine, ½ part; spirits of turpentine, 1 part; gutta percha, 1-6 part; sulphur, 2 parts; heat the oils separately to about 300 deg. F.; cool to 240 deg., and mix in the other materials, the sulphur last. Heat to 300 deg. F. for about an hour or until the mixture becomes pasty, and on cooling is soft and elastic.

(11041) F. W. B. says: My boat is 20 feet long by 4 feet 5 inches wide, with easy lines, and my engine is supposed to be a high-speed double-cylinder opposed motor, bore 4 inches, stroke 4 inches, weight less than 200 pounds. It is said to give 4 horse-power at 500 R. P. M., and I would like to know what size propeller you would advise me to use, and what should be the proper pitch, and whether it should be two fluke or three. A. The size of a screw depends upon so many things, that it is very difficult to lay down any rules for guidance. However, the following rules are given sometimes for ordinary cases, where the size and power of the boat does not exceed a speed of 20 knots per hour. First: The "pitch" of a propeller is the distance which any point in a blade, describing a helix, will travel in the direction of the axis during one revolution, the point being assumed to move around the axis. The pitch of a propeller with a uniform pitch is equal to the distance a propeller will advance during one revolution, provided there is no slip. In a case of this kind, the term "pitch" is analogous to the term "pitch of the thread" of an ordinary threaded screw. Let P = pitch of propeller in feet. Then

$$P = \frac{10133\,S}{R\,(100-s)}$$

In which S = speed of boat in knots, R = revolutions per minute of propeller, s = percentage of slip. Assuming a speed of 10 knots per hour for your boat, with engine running at 500 R. P. M., and assuming a 10 per cent slip, we get a pitch of

$$P = \frac{10133 \times 10}{500\,(100-10)} = 2.25 \text{ feet.}$$

This is probably high, due to the fact that we assumed a low percentage of slip.
Diameter of propeller =

$$K\sqrt{\frac{I.H.P.}{\left(\frac{R \times P}{100}\right)^3}}$$

K = constant = 17.5. I. H. P. = 4. R = 500 R. P. M. P = 2.25. Therefore, diameter of propeller under these conditions, namely, four blades to the screw, made of cast iron, would be approximately one foot diameter. To allow for any increased slip which may occur, and other contingencies which may arise, we would not advise a screw less than 2 feet in diameter, calculated on a pitch of 2 feet. This will easily allow for any increased speed desired over 10 knots up to 15 knots per hour.

(11042) C. J. N. asks how to draw on glass. A. To write or draw on glass, it is necessary to impart to the surface a certain degree of roughness. This may be done by grinding or etching, but much more easily by applying some appropriate varnish. A good matt varnish is made by dissolving in 2 ounces of ether, 90 grammes of sandarac and 20 grammes mastic, and adding benzol ⅓ ounce to 1½ ounces, according to the fineness of the matt required. The varnish is applied to the cold plate after it has set. The glass may be heated to insure a firm and even grain. To render the glass again transparent, after writing upon it, apply with a brush a solution of sugar or gum acacia. Still better as a surface for writing or drawing is a varnish of sugar. Dissolve equal parts of white and brown sugar in water to a thin syrup, add alcohol, and apply to hot glass plates. The film dries very rapidly, and furnishes a surface on which it is perfectly easy to write with pen or pencil. The best ink to use is India ink, with sugar added. The drawing can be made permanent by varnishing with a lac or mastic varnish.

(11043) W. F. J. asks how to make waxed paper on a small scale. A. Place cartridge or other paper on a hot iron and rub it with beeswax, or brush on a solution of wax in turpentine. On a large scale it is prepared by opening a quire of paper flat upon a table, and rapidly ironing it with a heavy hot iron, against which is held a piece of wax, which, melting, runs down upon the paper and is absorbed by it. Any excess on the topmost layer readily penetrates to the lower ones. Such paper is useful for making waterproof and airproof tubes, and for general wrapping purposes.

(11044) S. C. H. asks: 1. What is the meaning of "ampere hour"? A. An ampere hour is a current of one ampere flowing for one hour. This phrase is exactly the same in form as "horse-power hour" or one horse-power used for one hour. 2. How is the amperage of any light or coil measured? A. The amperes used by a light or coil are measured by an ammeter put into the circuit so that the current flows through it. 3. What are the necessary steps for a young man to get a position as electrician on board an ocean liner? A. To become an electrician in any position, learn the business thoroughly and then apply for the place you want. Make it appear that you are the man for the place, and you will be likely to get it.

(11045) C. W. N. asks: 1. Approximately how large a spark coil is needed in wireless telegraphy to transmit through a distance of one mile, and how large for a distance of five miles? A. A coil giving a spark one inch long will transmit one mile over water. Over land the spark length varies with the character of the surface. A coil giving a ten-inch spark will answer for a variety of distances and circumstances. 2. In winding a large spark coil in which the greatest amount of wire is placed on the middle part of the coil, I have learned that it is customary to leave a space between the core and the wire at the ends. Is there any disadvantage in winding so that the wire lies directly on the main insulating tube? A. The space is left because of the greater tendency of the spark to jump from the secondary into the primary as the ends of the coil are approached. See Hare's "Construction of Large Induction Coils," price $2.50 by mail. 3. Is there any better insulator than paraffine for use in the construction of coils? A. Paraffine or a heavy oil is employed. 4. What is the best material to use in separating the sections of the secondary? A. Hard rubber disks. 5. Are there any means by which the voltage of the secondary wire of a coil may be determined? A. Widely different estimates are to be found of the voltage necessary to force a spark through various lengths of dry air. There is no rule giving a certain result for lengths beyond a few centimeters.

(11046) J. G. M. asks if cast iron balls and cones can be cast so as to wear, and if they cannot, kindly state what other material can be used besides steel. A. Cast-iron balls and cones are not suitable for bearings for vehicles or machines. Nothing is better than truly finished steel balls and bearings, hardened.

(11047) C. G. W. says: Will you kindly inform me through your Notes and Queries column how I can artificially color a meerschaum pipe? A. Ordinarily the pipe is boiled for coloring in a preparation of wax which is absorbed, and a thin coating of wax is held on the surface of the pipe, and made to take a high polish. Under the wax is retained the oil of tobacco, which is absorbed by the pipe, and its hue grows darker in proportion to the tobacco used. A meerschaum pipe at first should be smoked very slowly, and before a second bowlful is lighted the pipe should cool off. This is to keep the wax as far up on the bowl as possible, and rapid smoking will overheat, driving the wax off and leaving the pipe dry and raw. A new pipe should never be smoked outdoors in extremely cold weather. Fill the pipe and smoke down about one-third, or to the height to which you wish to color. Leave the remainder of the tobacco in the pipe and do not empty or disturb it for several weeks, or until the desired color is obtained. When smoking, put fresh tobacco on the top and smoke to the same level. When once burnt the pipe cannot be satisfactorily colored, unless the burnt portion is removed and the surface again treated by the process by which meerschaum is prepared. The coloring is produced by action of the smoke upon the oils and wax which are superficially on the exterior of the pipe, and are applied in the process of manufacture.

(11048) F. B. C. asks for rules for calculating speed of pulleys. A. The diameter of the driver being given, to find the R. P. M. of the driven; Rule.—Multiply the diameter of the driver by its number of revolutions, and divide the product by the diameter of the driven; the quotient will be the number of revolutions of the driven. Ex.—24 inches diameter of driver × 150, number of revolutions, = 3,600÷12 inches diameter of driven = 300. The diameter and revolutions of the driver being given, to find the diameter of the driven, that shall make any given number of revolutions in the same time. Rule.—Multiply the diameter of the driver by its number of revolutions, and divide the product by the number of required revolutions of the driven; the quotient will be its diameter. Ex.—Diameter of driver (as before) 24 inches × revolutions 150 = 3,600. Number of revolutions of driven required = 300. Then 3,600÷300 = 12 inches. The rules following are but changes of the same, and will be readily understood from the foregoing examples. To ascertain the size of the driver: Rule.—Multiply the diameter of the driven by the number of revolutions you wish to make and divide the product by the required revolutions of the driver; the quotient will be the size of the driver. To ascertain the size of pulleys for given speed: Rule.—Multiply all the diameters of the drivers together and all the diameters of the driven together; divide the drivers by the driven; the answer multiply by the known revolutions of main shaft.

(11049) L. P. says: Will you give me a rule for finding the power a stream of water is capable of developing, when the size and drop of stream are known? A. The gross power of a fall of water is the product of the weight of water discharged in a unit of time into the total head, i. e., the difference of vertical elevation of the upper surface of the water at the points where the fall in question begins and ends. The term "head" used in connection with waterwheels is the difference in height from the surface of the water in the wheelpit to the surface in the penstock when the wheel is running. If Q = cubic feet of water discharged per second, D = weight of a cubic foot of water = 62.36 pounds, A = total head in feet, then $D \times Q \times H$ = gross power in foot pounds per second, and $D \times Q \times H \div 550$ = gross horse-power. A waterwheel or motor of any kind cannot utilize the total head H due to losses at the entrance and discharge from the wheel. There are also losses due to friction, etc., which place the average efficiency of waterwheels at about 75 per cent. Thus net

$$\text{horse-power} = 0.75 \times \frac{Q \times H \times D}{550}.$$

A head of water can be made use of in one or more of the following ways, namely: 1. By its weight, as in the water balance and overshot wheel. 2. By its pressure, as in turbines and in the hydraulic engines. 3. By its impulse, as in the Pelton waterwheel. 4. By a combination of the above. Referring to your question, we might say that it would be impossible to compute the horse-power of a stream of water when the size and head are known only. It would be necessary to measure the quantity of water which flows in a certain time. From this value Q could be determined in the formula, H could be measured, and the horse-power calculated. 2. A dynamo of what lighting capacity will a 3-horse-power gasoline engine run? A. A 3-horse-power gasoline engine would run a dynamo which could be operated on a lighting system carrying safely thirty 110-volt 16-candle power Edison incandescent lamps on a parallel circuit.

(11050) W. S. asks: Is it possible to consume all the oxygen in a confined quantity of air, viz., in a sealed iron pipe? A. Yes; by placing copper scraps in the pipe and heating the air in the pipe. The oxygen combines with the copper, forming a solid substance, and leaving the nitrogen uncombined.

(11051) C. M. writes: 1. I want to use a call bell in kitchen, battery to be in second story, from which run two wires. I want one push button in one room, one in second room, one in parlor, one in room down stairs, also one in dining room—five push buttons; how could I connect all buttons to work properly with only one bell? A. Carry one wire from one post of the battery to the bell, and from the other side of the bell a wire which shall branch through each push button to the other side of the battery. There will then be a complete and separate circuit through battery, bell and a push button. 2. I have one lamp, 8 candle power, 26 volts; could I light it with 14 cells improved standard Fuller battery? If so, how about the amperes it will use with 26 volts? A. You can light the lamp with 26 volts and 1 ampere of current. 3. How old is Mr. Edison? Also, who was the first that invented the electric light? I mean both the arc and incandescent lamps. A. Mr. Edison was born February 11, 1847. The first man who ever saw a spark from artificially excited electricity is said to have been Otto von Guericke in 1660. This was the first electric light. Sir Humphry Davy is credited with first producing an electric arc light in 1801. He had a battery of 3,000 plates, each four inches square, and used charcoal points made of wood, which he immersed in a mercury bath to increase the conductivity. With this he melted many refractory substances such as lime, platinum, sapphire, and diamond. The incandescent lamp was invented and perfected by Edison.

(11052) G. S. M. asks: Will you kindly let me know through the columns of your paper whether it is necessary for the temperature of the air to become 32 deg. F. or lower in order to produce a "white frost"? If not, please give reasons. A. It is necessary for the air to be at 32 deg. at the point where the white frost forms. It is not necessary for it to be at 32 deg. any distance above that point, even one foot above. The air is a nonconductor of heat, and may be several degrees warmer at a very little distance from the place where frost is forming. Vegetation and stones are better conductors of heat than is air, and hence become cooler than the air. Hence the dew is deposited on these, and the dew freezes to ice crystals, which is frost.

(11053) G. B. asks: We have tried different ways in cutting round glass rods of ½ inch to ⅝ inch without good results. Will you kindly advise best way of doing same? A. A glass rod is usually broken by making a cut on one side with a file or diamond and giving a quick bend at the point opposite to the cut. An improvement upon this method, although requiring more work, would be to make a cut entirely around the rod, and apply heat at the place where the cut is made. A red-hot piece of iron ⅝ inch in diameter will be the best for applying the heat to the rod. This may be fitted into a handle and used as a soldering tool is used in the hand.

(11054) J. P. A. asks: Comparing the chemical equivalents (atomic weights) given in Century Dictionary with those stated in text books on this subject, I find considerable difference in the figures. In some cases, the amounts are one-half for those of text books as against the amounts of Century Dictionary, while in other cases the differences of amounts are without definite proportion. If the determination of equivalents of elementary bodies has passed beyond the presumptive state, will you kindly advise me where the truth of this matter may be found? A. We should no more think of going to the Century Dictionary for the chemical equivalents, or atomic weights of elements, than we should think of going to an almanac seventeen years old. The Century Dictionary is most valuable in its field; but surely its field is not to give data which have been made far more correct since its publication seventeen years ago. The American Chemical Society has a committee upon atomic weights, and its figures reported from time to time are received as authority. Probably the most weighty name in connection with this work is that of Prof. F. W. Clarke, the chief chemist for many years of the United States Geological Survey. The determination of atomic weights has passed beyond the "presumptive stage," and the results may be found in any recent chemistry, such as Remsen's "College Chemistry."

(11055) A. M. asks: Please let me know what I would need to cause the sound of a clock to be transmitted a distance of, say, 150 feet by electricity. A. A simple device would consist of a telephone transmitter in front of the clock and a receiver at the point at which you would hear the ticking.

(11056) J. W. D. asks: 1. How long does it take to decompose one pound acidified water with a current of 100 volts? A. The time required to decompose a pound of water depends upon the amount of electricity used. If 13⅓ amperes are used at 100 volts it will require one hour. From this the time for any other current can be found, or the current for any other time. Water is decomposed with any voltage greater than 1.47 volts. You will see then that 100 volts is very much higher than is necessary. 2. How much does it cost to run a dynamo of 1,000 volts annually, including all expenses? A. That depends upon how many amperes the dynamo is to furnish. A dynamo giving 1,000 volts might be lighting a small village, or it might be lighting a large section of your city. The cost would not be the same in both cases.

(11057) G. G. S. asks: Please inform me as to the amount of current used by (1) ½-inch solid carbons, (2) ½-inch soft core carbons, (3) ⅝-inch solid carbons, (4) ⅝-inch soft core carbons, when used in a stereopticon on 110-volt alternating current circuit. A. Stereopticons are usually run with ½-inch carbons. We have never used one with a larger carbon. The ½-inch carbon will carry as high as 25 amperes, but 10 to 15 amperes is the usual current for such a lamp. A ⅝-inch carbon would carry 25-16ths as much current as a ½-inch carbon. The current would be proportional to the area of cross section of the carbon.

(11058) M. C. A. asks: Will you please inform me what size and how many feet of wire it will take to make an electric heater, 104 volts, say 5 to 7 amperes capacity? A. Seven amperes at 104 volts require 15 ohms of resistance. For a rise of 190 degrees F. the resistance rises 40 per cent. Hence about 5-7 as much wire will be needed if you wish to raise the temperature about to that of boiling water. No. 14 iron wire may be used. This has about 65 feet to an ohm. These are approximate numbers, and you can adjust the quantity to the temperature you wish to maintain.

(11059) J. O. D. says: Do you publish an Encyclopedia of Receipts and a book on patent laws? A. We recommend and can supply you with the "Scientific American Cyclopedia of Receipts, Notes and Queries," last edition containing 15,000 receipts, 736 pages, cloth bound, price $5. Our "Scientific American Reference Book," price $1.50, gives the patent laws. Always give full name and address when corresponding.

(11060) W. A. L. asks: Is there any other metal that can be used in a gravity battery besides zinc that will not dissolve? A. There is no way of obtaining electricity without using up some material. In the dynamo steam or water power is employed. In the battery we usually burn up zinc. It is just as impossible to produce electricity without a disappearance of some other form of energy as it is to heat a house and still have the coal, or cool a refrigerator and still have the ice.

(11061) C. S. J. asks: I wish to learn the cause of trichinæ in pork. A. The *Trichina spiralis* is a worm, a parasite of the hog. It is often found in great numbers in

the flesh of these animals, in the encysted condition but still alive. If such meat is eaten without cooking thoroughly, the parasite is taken into the body and is rapidly propagated. The worm came originally from the rat. As hogs eat rats, they pass into the hog and thence into man. The only preventive is thorough cooking. This kills the trichinæ. No rare or underdone pork should ever be eaten. The risk is too great. The cost of immunity is so little, that anyone may be safe. Cook all pork thoroughly. 2. The cause of ptomaine poisoning by eating pork. What causes the presence of the poison, how the poison can be prevented, and whether or not there is any way of detecting the presence of poison before using the meat? A. Ptomaines are formed by decomposition. If only fresh food is used, one will be safe from these poisons.

(11062) H. S. N. asks: I have been a reader of your paper for several years, and always enjoy reading it. I should like to submit a problem for solution. The problem is this: Several years ago I took a picture of a fast train while running, a Michigan Central flier, at a point about two miles east of Decatur. On development the plate showed a blur of 1-32 inch, i.e., the pilot did. I used a Vive extra rapid plate; the focus of the lens was 6 inches; the distance of the engine, the pilot, from the camera, 50 feet; the length of exposure, 1-100 of one second; camera was placed at an angle of 15 deg. with the track. What was the speed of the train? The camera was a Vive, 4¼x4¼, meniscus lens. A. The solution of your problem of the speed of the train is not difficult, at least so far as a sufficiently close approximation is concerned. Start with the fact that the image of the pilot moved 1-32 inch during exposure. Since the lens is 6-inch focus and the pilot is 50 feet away, the pilot moved across the line drawn through the center of the lens, 100 times 1-32 inch, or 3.125 inches, since 50 feet is 100 times 6 inches. And since the camera made an angle of 15 deg. with the track, we must divide the 3.125 inches by the sine of 15 deg. to find the distance the pilot moved during the exposure. This gives 12.07 inches as the distance the train moved in the time of exposure, or 1-100 second. In one second it moved 1,207 inches, or 100 feet 7 inches. This is a speed of somewhat over 71 miles per hour. As we said above, this is an approximate solution, but still not far from the result which an exact solution would give.

(11063) J. S. N. asks: Will you kindly answer in your column of Notes and Queries the inclosed questions relative to Roman computation? I suppose the matter is simple enough, but I have never come across any work explaining it, nor any person whom I have asked who could throw any light on the subject. A. Very little is known concerning the method by which the Romans used their very inconvenient notation for performing the ordinary calculations. They are supposed to have used the abacus for all except the most simple problems. This instrument is in common use now by all Chinamen, and it is not difficult for any one to see it used wherever these men may be found. A description of the abacus may be had from any encyclopedia. There was a rod for each denomination of numbers to millions, seven rods each carrying five balls. Another set of short rods corresponded to these, and had one ball sliding on each. They could thus count by fives and carry by tens. Other rods supplied their need for calculating ounces. Further than this their business did not require them to go; they never needed to divide the distance of the sun by the velocity of light. They died in total darkness in regard to both of these data of the universe. As we said at the outset, we do not know the detail of the method by which the Romans made their calculations. Their mode of writing numbers was not like ours by placing like denominations in the same column, but each letter had its significance, and each number could be added by itself on the abacus, since each rod meant a denomination.

(11064) W. D. W. says: Will you be kind enough to answer the following questions for one who is anxious to know and who has the greatest respect for your opinion on scientific matters? 1. Will electric wires, furnishing current for arc lights coming in contact with street trees, injure them, that is, when the insulating covering has worn off from rubbing against the branches of the tree? One of the tree and park commission of this city (Columbia, S. C.), a college professor and a very intelligent gentleman, insists that the electricity, that is, all that is taken by the tree in wet weather, will do no harm, while I hold to the opinion that it will ultimately kill it, and I wish to know which one of us is wrong. A. We have found by experience that leakage from electric arc light wires does injure the limbs of trees, particularly when the difference of potential is very great, although we do not believe it would kill the tree unless it was very young. 2. When a tree has been killed by escaping electricity, how long a time should elapse, in case the leak be located and stopped, before it will be safe to put another tree in its place? A. We see no reason why another tree cannot be put in at once if the ground has been removed. 3. Some very large oaks that are exposed to the smoke from the railroad workshops have died very recently, and I am anxious to know if the smoke is responsible for their dying. The shops have been there for a long time, and it seems that if the smoke is the sole cause the trees ought to have died long before this time. It may be possible, however, that loss of vitality on account of age may be partly responsible for their dying. A. If the trees are very close to the top of the smoke-stacks, we have no doubt that the trees have lost some vitality on account of it, as the products of combustion are very destructive to vegetable life, but the trees would have to be under the direct influence of the smoke.

(11065) C. D. asks: 1. What point below the freezing point do air, hydrogen, nitrogen, oxygen, become liquid? A. These temperature points are very nearly as follows in Fahr. degrees, below zero: Air, 312; hydrogen, 422; nitrogen, 317; oxygen, 297. 2. Please give me the address of a reliable company that sells chemicals and chemical apparatus. A. You had better deal with a firm in the city near your home than buy at a distance and pay transportation charges. Our advertising columns very often contain the advertisements of these dealers. We do not advertise dealers in the Notes and Queries column. 3. Where can I get some books on argon, helium, neon, krypton, and xenon, and give me the prices of them? A. We can send you many valuable papers on the rare gases of the atmosphere which have appeared in the SUPPLEMENT. Among them are argon, Nos. 1000, 1001, 1002, and others, price ten cents each; helium, Nos. 1056, 1057, price ten cents each. 4. What kind of chemical books, as organic chemistry, etc., so I can find liquid formene? What is formene? A. Formene is a tetrachloride of carbon CCl_4. Its preparation can be found in the Dispensatory. Its properties are those of an anæsthetic, similar to those of chloroform, soothing the pain of neuralgia and even causing insensibility. As it has been the cause of death also, it is not used by physicians. It is not a substance for an amateur to meddle with. 5. What are the uses of liquid air? A. At present liqud air is not put to any commercial use.

NEW BOOKS, ETC.

ANIMAL ROMANCES. By Graham Renshaw, M.B., F.Z.S. London: Sherratt & Hughes Co., 1908. 8vo.; 204 pp. Price, $3.

The book is illustrated by a number of most interesting half-tones showing some interesting beasts of Africa. One view of giraffes is most entertaining. The author has written a number of books on natural history and the present volume is a worthy successor to "Natural History Essays," "More Natural History Essays," "Final Natural History Essays."

DOCUMENTARY SOURCE BOOK OF AMERICAN HISTORY. 1606-1898. Edited with notes by William Macdonald. New York: The Macmillan Company, 1908. 12mo.; 116 pp. Price, $1.75.

The present volume has been prepared in response to a request frequently made by teachers who have used the author's "Select Charters," "Select Documents," and "Select Statutes," particularly designed for the course of instruction of an elementary or comprehensive character, all of which covers the colonial and the constitutional periods of American history in a single year. The book is filled with vitally important documents dealing with American history, such as the Navigation Act, the charters of various States, the Treaty of Paris, the Sugar Act, the Declaration of Independence, the Missouri Compromise, the Kansas-Nebraska Act, the Dred Scott Decision, the Civil Service Act. In all, there are 187 documents.

THE GARDENS OF ENGLAND IN THE MIDLAND AND EASTERN COUNTIES. Edited by Charles Holme. London and New York: John Lane Company, 1908. 4to.; 136 plates, 8 in color. Price, $3.50, postage 35 cents.

The publications of "The Studio" are noted for their sumptuousness, and the present volume is no disappointment. The illustrations are beautifully chosen and finely executed, the color plates being very remarkable productions. They are reproductions of water colors. The stately homes of England offer a never-failing field for the artist photographer. The text, which occupies some thirty-seven pages, is excellent.

AIR LIQUIDE, OXYGENE, AZOTE. Par Georges Claude, lauréat de l'Institut. Préface de M. d'Arsonval, membre de l'Institut. Paris: H. Dunod et E. Pinat. 1908. 8vo.; 400 pages, 149 figures. Price, $3.00.

This work comprises within its scope all the phases of its subject. It is divided into four parts. The first is devoted to the principles of the liquefaction of gases, with the history of the early experiments. The second part is upon the industrial liquefaction of the air, with the necessary discussion of the principles involved and the demonstration of the results which can be expected. The completeness of the work may be seen in the fact that it includes the American machine of J. F. Place, which was introduced to the public in the spring of 1908. The third part contains the many curious experiments which illustrate the wonderful phenomena of the realm of the absolute zero. The last part is devoted to that most important topic, the separation from each other of the gases of the air. It is in this part that the highest practical interest is centered, since it has become probable that liquid air will find its chief commercial value as a source of pure oxygen and nitrogen for manufacturing purposes, and not as a source of power or as a refrigerating agent. To all the departments of its subject the book is a valuable contribution.

THE COMING SCIENCE. By Hereward Carrington. With an Introduction by James H. Hyslop, Ph.D., LL.D. Boston: Small, Maynard & Co., 1908. 16mo.; 393 pages. Price, $1.50.

In presenting this work to the public the author must not be understood as indorsing or even as accepting all the views and theories that are advanced from time to time throughout the book. He offers these tentatively and merely as possible explanations for facts that, on the strength of existing testimony, he has assumed to be established. There are eighteen chapters, among which are "The Problems of Hypnotism"; "The Problems of Telepathy"; "The Problem of Sleep and Dreams"; "Modern Spiritualism"; "The Case of Mrs. Piper"; "The Nature of Apparitions"; "Experiments in Weighing the Soul"; "Premonitions." The book is arousing considerable attention.

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The Automobile Number of the Scientific American

Will issue on January 16, 1909

THIS YEAR WE HAVE DONE SOMETHING ENTIRELY NEW

WE called on 1200 manufacturers of automobiles and accessories for suggestions. The result was eye-opening. For days and days suggestions came in, most of them illuminating, helpful, and instructive. We read over every one of those letters and made up our minds to use each in some way. We classified them carefully and turned them over to a corps of expert writers on automobiles, with instructions to EMBODY THESE IDEAS IN THE BEST SERIES OF PRACTICAL ARTICLES AND SHORT MEATY NOTES that ever appeared in any one issue of a magazine.

Among the articles will be one on the commercial truck and delivery wagon. It tells just what the commercial self-propelled vehicle is capable of doing, compared with the horse-drawn vehicle of the same type.

The average automobilist is not an engineer. When his machine stops, he is all but helpless. Many of the 1200 thought it would be an act of mercy to help him out. Mr. Roger Whitman, technical director of the New York School of Automobile Engineers, has prepared a "TROUBLE CHART," which a man can carry in his hat, if need be, and consult if he finds himself in mechanical straits. A glance at that chart will tell any intelligent man, woman, or child how to locate a defect and what to do if a car refuses to run.

Magneto Ignition, because it is comparatively new, is a subject on which the automobile user needs enlightenment. Just what magneto ignition is, how it compares with coil ignition, and the comparative advantages of high and low tension, are ably explained in a lucid article.

The Two-cycle Engine is another innovation which ought to be dealt with in the opinion of the trade. Mr. E. W. Roberts, a well-known authority on the subject, has prepared an article which sets forth simply and accurately what the two-cycle engine is, and what it will do to simplify and improve the automobile.

Tires are found to demand more in the way of repair and renewals than any other part of the car. A tire expert has prepared an article, which the tire manufacturer ought to welcome, simply because it informs the chauffeur what he ought to do and what he ought not to do, and places the blame for much tire trouble where it properly belongs—on the man who drives the car. We think we have succeeded in explaining some of the mysteries of tire construction, and that we have laid a heavy finger on the cause of the trouble.

"Lubricants and Lubrication" is made the subject of some straight talk by Mr. Hanauer, whose chief business in life at present is to lecture on oil and oil devices at the New York School of Automobile Engineers. The driver of a car is set right on the subject of lubricants, and informed what lubricant to use for the various parts of his car. Mr. Hanauer explains all this clearly. What is more, he gives a few simple tests which will indicate whether the oils are what they purport to be.

Repairs are charged for at piratical prices. Automobile manufacturers rail at the garage keeper, because he is not fair to their cars. He puts them in a bad light. No manufacturer cares to learn how many dollars his car cost in repairs, particularly if most of the repairs are easily made. So we intend to publish an article **"Making Your Own Repairs,"** which will pluck out a painful thorn and make the owner of a car at least partly independent of the exorbitant garage man.

There will be a page full of novelties—short, illustrated articles about clever automobile inventions that save time and labor. Many of them will give the reader a little thrill of mechanical pleasure to learn that such simple—we might almost say obvious—devices are conceived and manufactured. Every one of them is a mechanical short cut.

The number will contain about 40 pages and will have a striking colored cover. The price will remain the same—10 cents.

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